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Effects of various emulsifiers on physicochemical and sensory attributes of cake during storage

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Abstract

Emulsifiers are important functional additives in modern food processing, which can emulsify and stabilize emulsions and perform many diverse functions in food product development. Typically numerous emulsifiers are used in baking industries to improve the quality of baked products. The objective of this study was to prepare a cake with three types of emulsifiers such as an ester of monoglyceride, glycerol monostearate and disodium phosphate and investigate the effects of emulsifiers on physicochemical properties, colour and sensory attributes of cake during the storage period. Cakes prepared with emulsifiers had lower specific gravity and higher dough yield than those prepared without emulsifiers. The protein, fat and ash contents of the cakes were dependent on emulsifier types throughout the storage period. L* values were decreased whereas a*, b* and firmness were increased for all samples after 30 days of storage. Control samples were not acceptable after 15 days of storage. There was no statistically significant difference in overall acceptability among all cakes prepared with emulsifiers. Therefore, the results showed that good quality cake could be made with the ester of monoglyceride, glycerol monostearate and disodium phosphate and quality could be maintained for up to 30 days without any nutritional changes.

1. Introduction

Cakes are sweet baked products highly consumed by people around the whole world because of their auspicious sensory attributes and low cost (Sozer *et al.,* 2011; Farimani *et al*., 2020). These are characterized by a dense, tender, uniform crumb structure, long shelf life and sweet taste (Gelinas *et al*., 1999; Farimani *et al*., 2020). Cake is delicious food liked by children and become popular among adults due to its convenience for eating. In modern times demand for ready-to-eat products like cake increases due to the spread in education, the woman at work and changing food habits of the consumer. It is one of the relished and palatable baked products which contain a combination of flour, sugar, eggs and butter or oil, with some varieties also requiring liquid (typically milk or water) and leavening agents (such as yeast or baking powder). The excellence of cake is affected by the steadiness of the ingredients used, and by the baking and mixing actions (Tireki, 2008).

Cakes are prepared with different types of stabilizers, emulsifiers, humectants etc. Emulsifiers are auxiliary agents that help to mix immiscible substances with each other (Dizlek and Gül, 2009; Özhamamci *et al.,* 2019). Various types of emulsifiers such as glycerol monostearate, lecithin and sorbitan monostearate are incorporated into the cake to enhance emulsifying properties, increase air incorporation, extend cake softness by holding considerable amounts of liquids, provide stability and also increase the final cake volume (Sahi and Alava, 2003; Rahmati and Tehrani, 2014; Eduardo *et al*., 2016).

Monoglyceride is synthesized by the esterification of glycerin with fatty acids synthetically. It is formed by the reaction with glycerin by fatty acid chains and is generally used as a non-ionic emulsifier. Monoglyceride promotes the improvement of the internal structure, texture and symmetry of the cake and enables the production of bulkier cakes. Besides, glycerol monostearate, white, odourless, sweet and hygroscopic,

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is the glycerol ester of stearic acid. It is used as a thickener, emulsifier, anti-aggregation and preservative in the food industry (Özhamamci, 2019). And disodium phosphate is a chemical added to foods, as a preservative and a flavour enhancer.

High volume, uniform crumb structure, tenderness, shelf life and tolerance to staling are the main criteria for a good quality cake (Gomez *et al*., 2007). Several studies have been shown cake quality characteristics could be enhanced by using various emulsifiers, humectants, stabilizers and different ingredients. Eggless cake properties such as moisture and specific gravity were affected by glycerol monostearate, lecithin and sorbitan monostearate (Rahmati and Tehrani, 2014). Glycerol monostearate and polyglycerol ester have affected the distribution and size of the air bubbles as well as decreased the fluidity in sponge cake (Sahi and Alava, 2003). The effects of gum arabic, guar gum, xanthan gum, carrageenan, hydroxypropyl methylcellulose in combination with glycerol monostearate and sodium stearoyl-2-lactylate on the quality characteristics of cakes have been conducted by Ashwini *et al*. (2009). Different preservatives such as potassium sorbate and sodium benzoate are used in cake to prevent yeast and mould growth and also enhance its keeping quality (Guynot *et al*., 2003).

Wheat is imported from many countries in Bangladesh. Wheat flour quality can be varied due to genetic and environmental origin (Blaszczak *et al*., 2004). Therefore, flour quality might impact cake quality. Emulsifiers are added to the cake to reduce egg quantity or replacement of eggs for improving cake quality. There are limited numbers of reports found on the effects of emulsifiers in cake such as an ester of monoglyceride, glycerol monostearate and disodium phosphate along with wheat flour, whole egg, preservatives and other ingredients during storage. Therefore this study aimed to prepare the cakes with different emulsifiers like ester of monoglyceride, glycerol monostearate and disodium phosphate and observe the effects of the emulsifiers on physicochemical properties, colour and sensory attributes of cake during storage.

2. Materials and methods

2.1 Ingredients

Wheat flour, sugar, baking powder and fresh eggs were purchased from local markets in Dinajpur, Bangladesh. Commercially available food-grade esters of monoglyceride, glycerol monostearate, disodium phosphate, guar gum, sorbitol, glycerol, propylene glycol, sodium benzoate, potassium sorbate were purchased from Paradise Scientific Company, Dhaka, Bangladesh.

2.2 Cake formulation and preparation

Sponge cake formulations are given in Table 1. Wheat flour and other ingredients for each cake were weighed accurately. Egg white and sugar were poured into a bowl and mixed in a mixing machine (NM-76, China) for ten minutes to produce a cream. Then various emulsifiers (ester of monoglyceride, glycerol monostearate and disodium phosphate) and additives (sorbitol, glycerol, propylene glycol, baking powder, sodium benzoate and potassium sorbate) were added. Egg yolk, wheat flour and oil were poured into the mixer and mixed by mixing machine for ten minutes to ensure proper distribution of all components. The bowl was scrapped and the batter was mixed for an additional two minutes. The cake batter was put into a pre-greased cake pan. All cakes were baked in an electric oven (JS-918, China) for twenty minutes at 180°C. The cakes were allowed to cool for one hour and then removed from the pans. The cooled cakes were packed in polypropylene bags and stored at room temperature for further use.

Table 1. Formulations of cake (quantities are given in flour basis: g/50 g of flour)

Ingredients	Cake 1	Cake 2	Cake 3	Cake 4	Control
Wheat flour	50	50	50	50	50
Sugar	60	60	60	60	60
Egg	60	60	60	60	60
Sodium bicarbonate	2	2	2	2	2
Citric acid	1	1	1	1	1
Ester of monoglyceride	1.5	1.5	1.5	-	-
Glycerol monostearate	0.2	0.2	-	0.2	-
Disodium phosphate	0.35	-	0.35	0.35	-
Sorbitol	2	2	2	2	2
Glycerol	1.2	1.2	1.2	1.2	1.2
Propylene glycol	0.07	0.07	0.07	0.07	0.07
Sodium benzoate	0.05	0.05	0.05	0.05	-
Potassium sorbate	0.05	0.05	0.05	0.05	-

2.3 Physical characteristics of sponge cake dough

The specific gravity of each type of sponge cake dough was determined by dividing the weight of the sponge cake dough by the weight of water. The dough yield of each type of sponge cake was measured by the loss of cake weight after baking. Specific gravity and dough yield was calculated by the following formula (Tietz, 1995; Kim *et al.,* 2012):

$$\text{Specific gravity (mL/g)} = \frac{\text{Weight of cake dough}}{\text{Weight of water}}$$

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$$\text{Dough yield (g/100 g)} = \frac{\text{Weight of cake}}{\text{Weight of dough}} \times 100$$

2.4 Proximate composition of sponge cake

2.4.1 Determination of moisture content

The moisture content of a cake is defined as the total amount of water that exists in the texture of a cake (Azmoon *et al.,* 2021). AOAC method 7.045 (2000) was used to determine the moisture content of the cake. Cake (3 g) was taken in a clean, dry and pre-weighed crucible. Then the cake was transferred to the oven and dried at 105°C for 24 hrs. After that, it was cooled in a desiccator and weighed. Moisture content was calculated by the following formula:

$$\%\ \text{Moisture} = \frac{W_1 - W_2}{W} \times 100$$

Where, W_1 = weight of sample with the crucible, W_2 = weight of dried sample with the crucible and W = weight of the sample.

2.4.2 Determination of protein

Protein content in the sample was measured spectrophotometrically according to the Bradford (1976) method with little modification. Sample (1 g) was taken in a beaker then 10 mL of distilled water was added to it. The sample was stirred with a magnetic stirrer and filtration was done with filter paper. Approximately 500 µL sample (after filtration) was taken into a falcon tube and diluted to 5 mL distilled water. Then, 5 mL of Bradford reagent was added and mixed by vortex (KMC-1300V, Korea) for a few minutes. The concentration of protein in the solution was determined from the absorbance at 595 nm (T60 U, PG instrument, United Kingdom). Protein content was calculated based on calibration curves of bovine serum albumin and expressed as a percentage.

2.4.3 Determination of fat

AOAC method 7.045 (2000) was used with some modification to determine the fat content of the Cake. The cake (3 g) was taken into the thimble. The thimble was attached to the Soxhlet apparatus which was attached with a round bottom flask containing 200 mL petroleum ether. The fat was extracted for 6 hrs. After that petroleum ether was evaporated at 80°C until the flask completely dried. Fat content was calculated by the following formula:

$$\%\ \text{Fat} = \frac{W_1 - W_2}{W} \times 100$$

Where W_1 = weight of evaporated flask with fat, W_2 = weight of empty flask and W = weight of the sample

2.4.4 Determination of total ash

AOAC method 14.006 (2000) was used to determine the total ash content. The cake (3 g) was weighed and transferred into a clean, dry and pre-weighed crucible. The crucible was then kept in a muffle furnace at 550°C for 5.5 hrs. It was cooled in the desiccator and weighed. The ash content was calculated by the following formula:

$$\%\ \text{Ash} = \frac{W_1 - W_2}{W} \times 100$$

Where W_1 = weight of ash with the crucible, W_2 = weight of empty crucible and W = weight of the sample

2.4.5 Determination of carbohydrate content

The total carbohydrate content of any food product has been calculated by the difference method for many years rather than analysed directly. The carbohydrate content of the developed samples was determined by subtracting the measured protein, fat, ash, and moisture from 100 as described by Roshid *et al*. (2016) and Roni *et al*. (2021) using the formula:

Percentage of Carbohydrate = 100 − {moisture +protein+ ash+ fat}.

2.5 Firmness of cake

Firmness was measured with a penetrometer (Gy-4, China). An 8 mm diameter cylindrical probe penetrated the cake surface at a 1 mms^{-1} speed. After that automatic data was shown on the penetrometer screen. Data were expressed as kg/min.

2.6 Colour determinations of cake

The colour attributes (L^*, a^* and b^* values) of the sponge cake samples from the crust of the cakes were measured using a colour measurement spectrophotometer (Minolta Camera, Tokyo, Japan).

2.7 Sensory evaluation

Consumer acceptance tests were evaluated using a 9-point hedonic scale (Stone and Sidel, 1993; Wazed *et al*., 2021; Wazed and Islam, 2021; Khatun *et al*., 2022), where 1 = disliked extremely and 9 = liked extremely. A total of 30 semi-trained panellists who were selected from the university who are familiar with cake. Panellists were facilitated to wash their mouths with tap water in between evaluations. The samples were placed on a white plate and were identified with random three-digit numbers. Sensory characteristics were colour, flavour, texture, taste and overall acceptability.

2.8 Statistical analysis

Each experiment was done in triplicate. The results were expressed as mean ± standard deviation and were analyzed by R (version 2.13.1). Significant differences

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between the means were determined by Duncan's Multiple Range Test. $P < 0.05$ was considered as a level of significance.

3. Results and discussion

3.1 Proximate composition of cake during storage

Proximate compositions of cake prepared with various emulsifiers during storage are shown in Table 2. Moisture, protein, fat, ash and carbohydrate content of cake ranged from 10.36% to 16.04%, 6.40% to 13.62%, 22.16% to 33.76%, 0.49% to 1.15% and 42.79% to 58.98%, respectively. The moisture content values of all cakes adding emulsifiers were higher than the control sample. Similar results were also obtained in the other studies (Manisha *et al.,* 2012). Emulsifiers stimulated the incorporation of air as well as enhanced the aeration capacity of cake (Rodríguez-García *et al.,* 2014). Therefore, moisture migrations from the crumb to the crust through redistribution have significant changes during storage (Stankov, 2016; Noorlaila, 2017). Seyhun *et al.* (2003) found higher moisture content using purawave and diacetyl tartaric esters of monoglycerides in cakes. Sowmya *et al.* (2009) revealed that cake prepared with emulsifiers glycerol monostearate and sodium stearoyl-2-lactylate (GMS and SSL) had higher moisture content than cake prepared without emulsifiers.

In this study, it was observed that the protein content was high in the cake prepared with various emulsifiers as compared to the control cake without emulsifiers. The results also show that there was a significant difference in protein content at a storage time of 30 days. The cake prepared with various emulsifiers would greatly improve the protein quality of the samples. This could be due to the emulsifier-to-protein ratio, which illustrates the effect of a hydrophilic emulsifier on the protein coverage of fat globules in emulsions (Courthaudon *et al.,* 1991). In addition, it has been reported that roasting, baking, and frying could adversely affect the nutritive value of food proteins mainly because of the Maillard reaction (Swaminathan, 1986). In addition, fat is an important factor that helps in improving the texture as well as rheology and overall quality of the product. The results of fat content showed that the samples were significantly different. Due to the similar amount of fat content in the cake prepared with various emulsifiers, the calorie content of the products did not vary greatly. Besides, the results of the ash content showed that there was no significant difference in the cake prepared with various emulsifiers which implies that there was not much of a difference in the ash content after the addition of emulsifiers. The low content of ash in the control sample may have been due to the method used (Kim *et al.,* 2012).

3.2 Physical attributes of cake

The specific gravity and dough yield of cakes is shown in Table 3. Low specific gravity implies that more air is incorporated into the cake (Turabi *et al.,* 2008). Cake prepared with an ester of monoglyceride, glycerol monostearate and disodium phosphate had lower specific gravity as compared to other cakes. Control cake showed higher specific gravity than cakes prepared with emulsifiers. Mixing conditions, amount of egg white, baking powder and water vaporization during baking could be influenced by specific gravity in the cake

Table 2. Effects of emulsifiers on proximate composition of cake during storage.

Composition (%)	Storage (days)	Cake 1	Cake 2	Cake 3	Cake 4	Control
Moisture	0	6.00 ± 3.08^{Aa}	12.96 ± 1.52^{Aab}	13.01 ± 0.24^{Bab}	13.14 ± 0.23^{Bab}	10.36 ± 0.05^{Bb}
	15	16.04 ± 2.41^{Aa}	14.81 ± 1.51^{Aab}	13.83 ± 0.19^{Aab}	15.40 ± 1.10^{Aa}	12.48 ± 0.28^{Ab}
	30	16.63 ± 2.38^{Aa}	14.08 ± 0.79^{Aa}	13.81 ± 0.05^{Aab}	15.01 ± 0.38^{ABa}	Not acceptable
Protein	0	7.55 ± 0.35^{Ca}	7.90 ± 0.61^{Ba}	6.92 ± 0.15^{Bab}	7.60 ± 0.23^{Ba}	7.85 ± 0.24^{Ba}
	15	11.59 ± 0.27^{Bab}	11.25 ± 0.51^{Aab}	10.44 ± 2.24^{Ab}	12.36 ± 0.33^{Aa}	10.47 ± 1.94^{Ab}
	30	13.62 ± 0.75^{Aa}	12.53 ± 0.40^{Aa}	11.90 ± 1.98^{Ab}	12.17 ± 1.47^{Aab}	Not acceptable
Fat	0	24.86 ± 0.197^{Aa}	24.63 ± 0.52^{Ba}	24.65 ± 0.32^{Ba}	22.35 ± 0.256^{Aab}	22.16 ± 7.82^{Bab}
	15	23.91 ± 1.03^{Ab}	26.02 ± 1.14^{Aab}	26.10 ± 1.57^{Aab}	23.85 ± 3.981^{Ab}	33.76 ± 6.11^{Aa}
	30	23.70 ± 0.84^{Ab}	27.08 ± 1.32^{Aa}	25.56 ± 3.44^{Aab}	24.57 ± 1.36^{Aab}	Not acceptable
Ash	0	1.03 ± 0.01^{Aa}	1.03 ± 0.076^{Aa}	1.08 ± 0.005^{Aa}	1.02 ± 0.03^{Aa}	0.65 ± 0.15^{Ab}
	15	1.15 ± 0.171^{Aa}	1.09 ± 0.120^{Aa}	1.11 ± 0.098^{Aa}	1.03 ± 0.103^{Aa}	0.49 ± 0.026^{Ab}
	30	0.92 ± 0.12^{Aa}	0.94 ± 0.08^{Aa}	0.95 ± 0.09^{Aa}	0.99 ± 0.02^{Aa}	Not acceptable
Carbohydrate	0	50.54 ± 3.24^{Ab}	54.98 ± 0.31^{Aab}	54.34 ± 0.58^{Aab}	55.88 ± 1.18^{Aa}	58.98 ± 7.86^{Aa}
	15	45.80 ± 0.63^{Bab}	46.82 ± 1.21^{Bab}	48.50 ± 4.1^{Aa}	47.34 ± 2.65^{Ba}	42.79 ± 4.47^{Bb}
	30	47.11 ± 3.85^{Aa}	45.35 ± 1.01^{Bab}	47.76 ± 5.57^{Aa}	47.24 ± 2.48^{Ba}	Not acceptable

Values are presented as mean±SD. Values with different lowercase superscripts within the same row are statistically significantly different ($p<0.05$) among cakes while values with different uppercase superscripts within the same column are statistically significantly different ($p<0.05$) among storage time.

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Table 3. Effects of emulsifiers on physical attributes and firmness of cake.

Properties		Cake 1	Cake 2	Cake 3	Cake 4	Control
Specific gravity (mL/g)		1.43±0.00^{c}	1.55±0.06^{ab}	1.52±0.04^{bc}	1.51±0.00^{bc}	1.65±0.007^{a}
Dough yield (g/100g)		90.22±0.63^{b}	91.26±0.43^{ab}	90.11±0.90^{b}	92.39±0.37^{a}	90.91±0.05^{b}
Firmness (kg/min)	Storage days 0	0.27±0.01^{Aa}	0.25±0.06^{Aa}	0.27±0.09^{Aa}	0.38±0.25^{Aa}	0.35±0.05^{Aa}
	15	0.43±0.03^{Aa}	0.49±0.07^{Aa}	0.52±0.15^{Aa}	0.49±0.26^{Aa}	0.74±0.24^{Aa}
	30	0.42±0.13^{Aa}	0.43±0.11^{Aa}	0.49±0.18^{Aa}	0.49±0.39^{Aa}	Not acceptable

Values are presented as mean±SD. Values with different lowercase superscripts within the same row are statistically significantly different ($p<0.05$) among cakes while values with different uppercase superscripts within the same column are statistically significantly different ($p<0.05$) among storage time.

(Rahmati and Tehrani, 2014).

Moisture, air and CO_2 might be influenced by dough yield. Cake prepared with glycerol monostearate and disodium phosphate had a higher dough yield whereas cake prepared with an ester of monoglyceride and disodium phosphate had a lower dough yield. This could be due to different emulsifiers holding different amounts of CO_2 and air during storage.

3.3 Firmness of cake during storage

Cake firmness increased as the storage time increased (Pizarro *et al*., 2013). Firming the crumb during storage is a common phenomenon (Ji *et al.*, 2010). It depends on the migration of water from the moist central crumb to the dry crust into the cake. Another one is starch retrogradation (Zhou *et al*., 2011). The firmness of the cake ranges from 0.25 to 0.74 kg/min (Table 3). Cakes prepared with disodium phosphate and glycerol monostearate had higher firmness than other cakes at 0 days. Cake prepared without emulsifiers had lower firmness than cake prepared with emulsifiers such as glycerol monostearate and disodium phosphate. One of the reasons might be the increased moisture content of the cake crumb and the increased cake volume. The other possible explanation is that, by adding emulsifiers, the air cells tended to distribute evenly and thus soften the cakes (Zhou *et al*., 2011).

3.4 Colour attributes of cake during storage

The colour attributes of cakes are shown in Table 4. The control sample had a higher lightness and lower redness and yellowness than the cake prepared with various emulsifiers at 0 days. It might be the browning reaction that occurred in a cake prepared with emulsifiers during baking (Rahmati and Tehrani, 2014). On the other hand, L* values were decreased whereas a* and b* values were increased for all samples after 30 days of storage, which is assumed to be due to the water loss of treatments during storage since water plays a great role in the brightness of food substances (Pratiwi and Ananingsih, 2021). This might be an interaction between emulsifiers and amylose. There were no significant differences in L*, a* and b* values among various cakes made with different emulsifiers.

3.5 Sensory attributes of cake during storage

Various emulsifier impacts on the sensory attributes of cakes are shown in Table 5. The sensory profile of the cakes was evaluated in terms of colour, flavour, texture, taste and overall acceptability at 0 and 30 days of storage. The colour was similar for all samples at zero days. However, colour decreased after 30 days of storage for all samples. This is mainly due to a decrease in lightness. Cake prepared with an ester of monoglyceride and disodium phosphate had the highest flavour and taste

Table 4. Effects of emulsifiers on colour attributes of cake during storage

Crust colour	Storage (days)	Cake 1	Cake 2	Cake 3	Cake 4	Control
L*	0	43.36 ±6.13^{Ab}	48.18±1.53^{Aab}	47.57±7.58^{Aab}	50.30±0.89^{Aa}	56.81±8.38^{Aa}
	15	53.09 ±3.31^{Aa}	56.41±7.05^{Aa}	53.23±0.60^{Aa}	47.49±10.57^{Ab}	57.14±2.91^{Aa}
	30	42.73±0.03^{Aab}	48.17±4.73^{Aa}	41.75±7.91^{Bab}	40.65±7.51^{ABb}	Not acceptable
a*	0	10.31±6.66^{Aa}	8.38±12.75^{Aab}	11.52±11.05^{Aa}	8.86±8.35^{Bab}	6.47±8.66^{Bb}
	15	16.15±2.18^{Aab}	15.05±1.97^{Aab}	15.36±1.45^{Aab}	18.49±0.25^{Aa}	14.97±0.66^{Ab}
	30	15.65±0.62^{Aab}	16.97±0.29^{Aab}	14.72±2.27^{Ab}	18.17±0.17^{Aa}	Not acceptable
b*	0	31.51±2.81^{Ba}	31.41±1.13^{Ba}	32.57±7.33^{Aa}	33.92±1.45^{Aa}	31.93±5.99^{Aa}
	15	39.78±2.24^{Aa}	38.50±1.33^{Aa}	38.15±0.32^{Aa}	34.47±10.28^{Aab}	34.70±0.38^{Aab}
	30	32.17±2.96^{Ba}	36.54±2.29^{ABa}	33.88±3.79^{Aa}	31.59±7.68^{Aab}	Not acceptable

Values are presented as mean±SD. Values with different lowercase superscripts within the same row are statistically significantly different ($p<0.05$) among cakes while values with different uppercase superscripts within the same column are statistically significantly different ($p<0.05$) among storage time.

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Table 5. Effects of emulsifiers on sensory attributes of cake during storage.

Sensory characteristics	Storage (days)	Cake 1	Cake 2	Cake 3	Cake 4	Control
Colour	0	8.27±0.23^{Aa}	8.05±0.07^{Aa}	8.00± 0.00^{Aa}	8.10± 0.00^{Aa}	8.1± 0.14^{a}
	30	8.00±0.14^{Aab}	7.75±0.07^{Ab}	7.90±0.14^{Aab}	8.20± 0.14^{Aa}	Not acceptable
Flavour	0	7.60±0.00^{Aa}	7.55±0.07^{Aa}	7.70±0.28^{Aa}	7.65±0.21^{Aa}	7.75±0.07^{a}
	30	7.75±0.21^{Aa}	7.65±0.21^{Aa}	8.10±0.00^{Aa}	8.00±0.00^{Aa}	Not acceptable
Texture	0	7.95±0.21^{Aa}	7.80±0.00^{Aa}	7.75±0.07^{Aa}	7.30±0.28^{Ab}	7.75±0.07^{a}
	30	7.75±0.07^{Aa}	7.95±0.35^{Aa}	7.85±0.07^{Aa}	8.00±0.28^{Aa}	Not acceptable
Taste	0	7.70±0.42^{Aa}	7.85±0.21^{Aa}	7.86±0.06^{Ba}	7.85±0.07^{Aa}	7.70±0.14^{a}
	30	7.70±0.28^{Ab}	7.9±0.00^{Aab}	8.35±0.07^{Aa}	8.15±0.15^{Aab}	Not acceptable
Overall acceptability	0	7.95±0.21^{Aa}	7.80±0.14^{Aa}	7.70±0.14^{Aa}	7.70±0.00^{Ba}	7.75±0.21^{a}
	30	7.90±0.28^{Aa}	7.75±0.21^{Aa}	8.05±0.07^{Aa}	8.15±0.07^{Aa}	Not acceptable

Values are presented as mean±SD. Values with different lowercase superscripts within the same row are statistically significantly different ($p<0.05$) among cakes while values with different uppercase superscripts within the same column are statistically significantly different ($p<0.05$) among storage time.

scores as compared to other cakes. Flavour and taste might be depending on the emulsifier type. Meanwhile, the texture is the organoleptic attribute that influences the acceptance of consumers of the baked product (Noorlaila *et al.,* 2017). Cake prepared with glycerol monostearate and disodium phosphate had the highest texture and overall acceptability scores than other cakes. However, there was no significant difference in overall acceptability among all cakes prepared with emulsifiers.

4. Conclusion

Three emulsifiers were used to prepare the cake and the impacts of emulsifiers on the physical and nutritional quality of the cake during storage were investigated. Based on the findings of this study, using the emulsifiers increased firmness and dough yield but had low specific gravity as compared to the control sample. Significant differences were found in protein content throughout the storage period for cake prepared with an ester of monoglyceride, glycerol monostearate and disodium phosphate. The results of the sensory evaluation indicate that each cake is slightly different in colour, taste and texture for consumers. There were no significant differences in L*, a*, b* values and overall acceptability among various cakes made with different emulsifiers. As a result, a good quality cake made with the ester of monoglyceride, glycerol monostearate and disodium phosphate would be more attractive to consumers, especially children.

Conflict of interest

The authors declare no conflict of interest.

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