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Effect of different levels of whey protein concentrate and emulsifier gel on storage attributes of eggless sponge cake

Vyakhaya and John David

Abstract
Effect of complete substitution of egg with Whey Protein Concentrate (WPC) and combination of emulsifiers in gel form having different properties and function were used to study the improvement in property of eggless sponge cake. The present research investigated WPC and emulsifier gel improved the quality of eggless sponge cake by providing superior aeration to the batter, enhanced volume and texture of sponge cake with fine crumb structure. Sponge cake developed with 6% WPC and 15% emulsifier gel was found to be superior in terms of overall acceptability in comparison to others Results shows that the blend of developed emulsifiers gel along with WPC used have interactively improved the properties of eggless sponge cake with minimum use of oils and fats in making, it was also observed that the product developed was of desired flavor and texture.

Keywords: Emulsifiers, eggless cake, WPC, shelf life

Introduction
In India, the baking sector is most likely the most important of the processed food industry. The country's yearly bread, bun, muffin, biscuit, and cake output is projected to be over 16.4 lakh tonnes. Cakes, which are highly popular in Indian bakeries, have a distinct place among bakery products. The egg is a crucial component in the cake's creation. Bakers have been able to add colour, flavour, and texture to their products thanks to the use of eggs. In the bakery industry, eggs serve a special purpose. Due to the existence of phospholipids with surface-active qualities, bakers used eggs and lecithin as natural emulsifiers in the early days (Goel *et al*., 2007).
Different kinds of emulsifiers may be used to create a wide range of characteristics in cakes, such as high volume, consistent crumb structure, softness and shelf life (Gomez *et al*. 2007) [5], all of which can be found in high-quality cakes. Different emulsifiers have previously been explored to replace eggs in cake recipes in some or all cases. Some of the most often used emulsifiers, including GMS, DMG, and SSL, were applied to the eggless cake samples in conjunction with various hydrocolloids. To simulate the rheological properties of gluten-free cake batter, researchers (Turabi *et al*. 2008) [21] used rice flour, gums, and an emulsifier to create a gluten-free cake batter. Polysorbate 60 (PS–60) and sodium stearoyl-2 lactylate (SSL) were shown to have an impact on the rheological and baking qualities of cake batters containing 120 g of egg on a flour basis (Jyotsna *et al*. 2004) [8].
When it comes to storing cakes, they may survive anywhere from a few days to a few weeks. Cakes with great volume and softness are the result of balanced formulations in high-quality cakes. In general, cakes having a smaller specific volume tend to be more stable. A cake's softness is due to sugar and fat, while its firmness comes from eggs (Hodge, 1977). Compared to breads, cakes take a long time to get stale because they contain more fat and less wheat. Native starches have been recommended as partial substitutes for cake flour because of the lower quantities of unstable starch that may delay the process of cake staling (Kim and Walker, 1992) [9].
Cakes have to be kept for many weeks before they can be tested for staling, which takes a long time to create new cake compositions and techniques. Speeding up testing to determine the shelf life of food is a possibility (Labuza and Schmidl, 1985) [10]. Storage conditions may have a significant impact on baked products (such as bread, cakes, and biscuits) in terms of their flavour and nutritional value (Botosoa *et al*., 2015; Daz-Ramrez *et al*., 2016) [2]. These flour matrices (gelatinized starch and gluten) and a tiny quantity of water are aged via a process known as Staling. Due to water migration and starch recrystallization (or "retrogradation"), previous research on bread staling has highlighted the relevance of drying and starch recrystallization (Botosoa *et al*., 2015; Wang *et al*., 2015) [2, 23].

Objective
To study the shelf life of developed sponge cake.

Materials and Methods
Ingredient Used: For the preparation of Cake Premix following ingredients was used:

Materials
The raw ingredients for Cake mix are Refined wheat flour (Sanghvi MP), Powder Sugar (Local Vendor), Whey protein concentrate-80% (Meggle, Germany), Tapioca Starch (Apple, India), Sodium Bicarbonate (Tata India), Salt (Tata India), Sodium Aluminium Phosphate (Asharam, Delhi), Xanthan Gum (Asharam, Delhi), Vanillin Flavour (Mane, India)

Formulation of Cake Premix: To create the final product, the following proportions were used:

Table 1: Formulation for cake premix

Formulation Cake Premix		
Ingredients	**Source**	**Quantity (%)**
Refined wheat flour	Sanghvi MP	44
Powder Sugar	Local Vendor	40
Whey protein concentrate-80%	Meggle, Germany	6
Tapioca Starch	Apple, India	12.5
Sodium Bicarbonate	Tata India	0.8
Salt	Tata India	0.5
Sodium Aluminium Phosphate	Asharam, Delhi	1
Xanthan Gum	Asharam, Delhi	0.15
Vanillin Flavour	Mane, India	0.25

Method

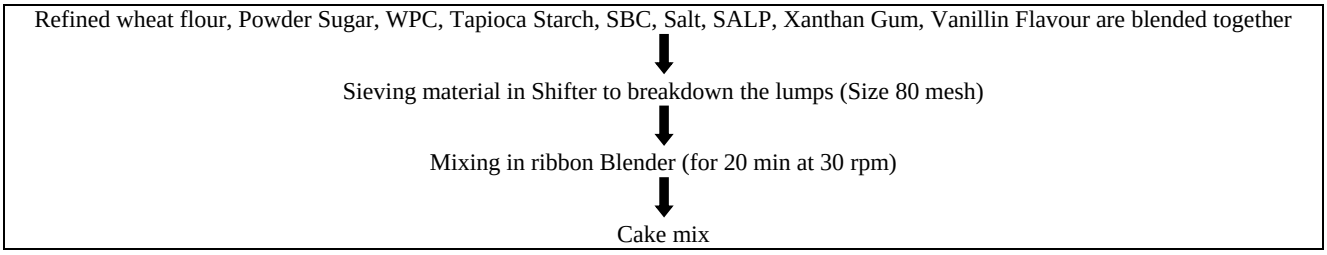

Fig 1: Flowchart for preparation of Cake Premix Cake Mix

After Recipe

Ingredients	Qty
Cake Mix	1000 g
Water	500 g
Oil	50 g
Emulsifier	15 g

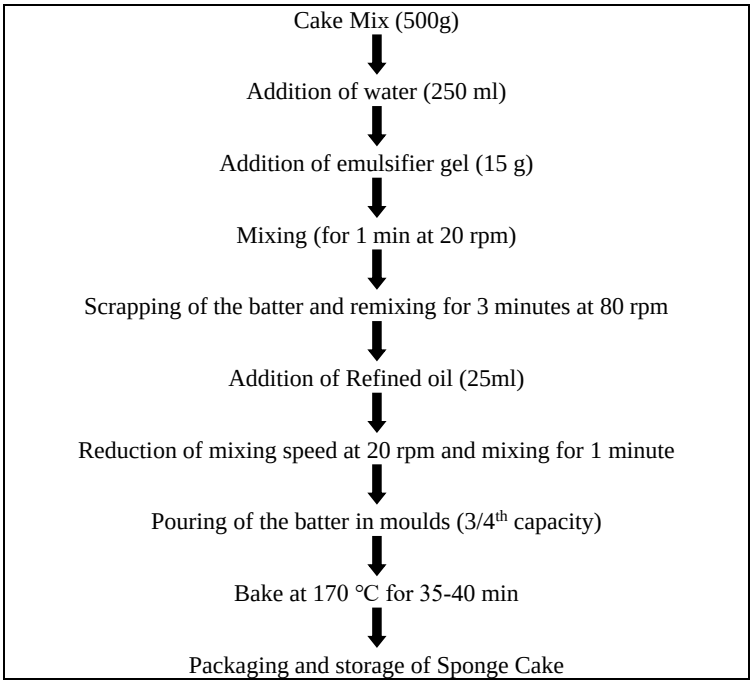

Fig 2: Flowchart for preparation of sponge cake

Results and Discussion

Storage Study: Shelf life was estimated by 28 days storage study of sample with 7 days intervals.

Effect of storage on acidity % of prepared sponge cake stored at refrigerated temperature (4 ℃)

Table 2: Effect of storage on acidity percent of prepared sponge cake stored at refrigeration temperature (4 ℃)

Days Interval		Replications				
		1	2	3	4	5
0th		0.12	0.12	0.13	0.13	0.13
7th		0.14	0.13	0.13	0.14	0.14
14th		0.14	0.15	0.15	0.15	0.15
21th		0.15	0.16	0.16	0.14	0.15
28th		0.17	0.17	0.16	0.17	0.17
Mean		0.14	0.15	0.15	0.15	0.15
Range	Minimum	0.12	0.12	0.13	0.13	0.13
	Maximum	0.17	0.17	0.16	0.17	0.17

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average acidity percentage in eggless sponge cake samples increased during the storage period. The acidity percent was highest on 28th Day with 0.17 followed by 21th Day (0.15), 14th Day (0.15), 7th Day (0.14) and 0th Day (0.13) contains least percent of acidity.

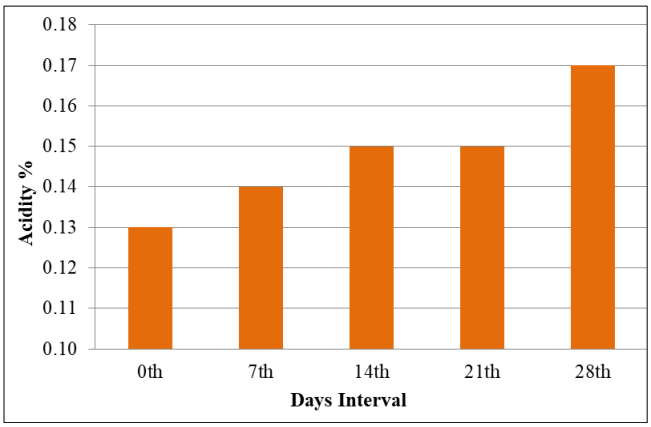

Fig 3: Graphical representation for acidity % of prepared sponge cake stored at refrigerated temperature (4 ℃)

Effect of storage on microbial properties of prepared sponge cake stored at refrigerated temperature (4 ℃)

Table 3: Effect of storage on standard plate count (10^5cfu/g) of prepared sponge cake stored at refrigeration temperature (4 ℃)

Replications		Days Interval				
		1	2	3	4	5
0th		2.82	2.84	2.83	2.82	2.82
7th		2.96	2.94	2.97	2.97	3.60
14th		3.64	3.60	3.60	3.60	3.60
21th		4.53	4.62	4.64	4.62	4.66
28th		5.63	5.65	5.67	5.64	5.62
Mean		3.92	3.93	3.94	3.93	3.93
Range	Minimum	2.82	2.84	2.83	2.82	2.82
	Maximum	5.63	5.65	5.67	5.64	5.62

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average standard plate count in eggless sponge cake samples increased during the storage period. The standard plate count was highest on 28th Day with 5.62 followed by 21th Day (4.66), 14th Day (3.60), 7th Day (3.60) and 0th Day (2.82) contains least standard plate count.

Table 4: Effect of storage on yeast and mold count (10^2cfu/g) of prepared sponge cake stored at refrigeration temperature (4 ℃)

Days Interval		Replications				
		1	2	3	4	5
0th		1.36	1.35	1.36	1.32	1.34
7th		2.26	2.25	2.25	2.26	2.24
14th		2.74	2.77	2.75	2.76	2.75
21th		3.14	3.17	3.14	3.12	3.16
28th		3.84	3.83	3.82	3.82	3.84
Mean		2.67	2.67	2.66	2.66	2.67
Range	Minimum	1.36	1.35	1.36	1.32	1.34
	Maximum	3.84	3.83	3.82	3.82	3.84

Showing the storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average yeast and mold count (102cfu/g) in eggless sponge cake samples increased during the storage period. The yeast and mold count (102cfu/g) was highest on 28th Day with 3.84 followed by 21th Day (3.16), 14th Day (2.75), 7th Day (2.24) and 0th Day (1.34) contains least percent of yeast and mold count.

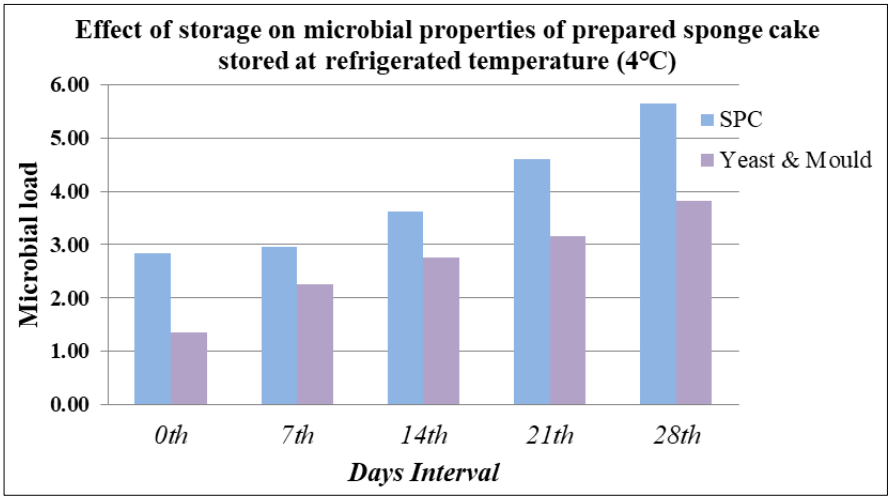

Fig 4: Graphical representation of microbial properties of prepared sponge cake stored at refrigerated temperature (4 ℃)

Effect of storage on sensory attributes of prepared sponge cake stored at refrigerated temperature (4 ℃)

Table 5: Effect of storage on colour and appearance of prepared sponge cake stored at refrigeration temperature (4 ℃)

Replications		Days Interval				
		1	2	3	4	5
0th		8.01	7.96	8.07	8.03	8.08
7th		7.86	7.84	7.85	7.86	7.86
14th		7.67	7.68	7.68	7.69	7.68
21th		7.32	7.31	7.31	7.34	7.34
28th		7.22	7.21	7.24	7.21	7.24
Mean		7.62	7.60	7.63	7.63	7.64
Range	Minimum	7.22	7.21	7.24	7.21	7.24
	Maximum	8.01	7.96	8.07	8.03	8.08

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average colour and appearance score for eggless sponge cake samples decreased during the storage period. The colour and appearance was highest 0th Day with 8.08 followed by 7th Day (7.86), 14th Day (7.68), 21th Day (7.34) and 28th Day (7.24) contains lowest score for colour and appearance

Table 7: Effect of storage on flavour of prepared sponge cake stored at refrigeration temperature (4 ℃)

Days Interval		Replications				
		1	2	3	4	5
0th		8.21	8.26	8.29	8.27	8.23
7th		8.17	8.16	8.17	8.15	8.16
14th		8.10	8.12	8.11	8.11	8.10
21th		8.02	8.06	8.05	8.02	8.04
28th		7.88	7.89	7.88	8.01	7.79
Mean		8.08	8.10	8.10	8.11	8.06
Range	Minimum	7.88	7.89	7.88	8.01	7.79
	Maximum	8.21	8.26	8.29	8.27	8.23

Effect of storage on flavour of prepared sponge cake stored at refrigeration temperature (4 ℃)

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average flavour score for eggless sponge cake samples decreased during the storage period. The flavour score was highest 0th Day with 8.23 followed by 7th Day (8.16), 14th Day (8.10), 21th Day (8.04) and 28th Day (7.79) contains lowest score for flavour.

Table 6: Effect of storage on volume and texture of prepared sponge cake stored at refrigeration temperature (4 ℃)

Days Interval		Replications				
		1	2	3	4	5
0th		8.87	8.85	8.87	8.84	8.85
7th		8.72	8.72	8.74	8.73	8.72
14th		8.67	8.68	8.68	8.65	8.68
21th		8.51	8.54	8.53	8.54	8.54
28th		8.35	8.36	8.34	8.36	8.36
Mean		8.62	8.63	8.63	8.62	8.63
Range	Minimum	8.35	8.36	8.34	8.36	8.36
	Maximum	8.87	8.85	8.87	8.84	8.85

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average volume and texture score for eggless sponge cake samples decreased during the storage period. The volume and texture score was highest 0th Day with 8.85 followed by 7th Day (8.72), 14th Day (8.68), 21th Day (8.54) and 28th Day (8.36) contains lowest score for volume and texture.

Table 8: Effect of storage on overall acceptability of prepared sponge cake stored at refrigeration temperature (4 ℃)

Replications		Days Interval				
		0th	7th	14th	21th	28th
0th		8.64	8.62	8.67	8.68	8.66
7th		8.62	8.58	8.62	8.61	8.63
14th		8.56	8.55	8.55	8.56	8.56
21th		8.32	8.34	8.35	8.34	8.34
28th		8.26	8.25	8.26	8.26	8.25
Mean		8.48	8.47	8.49	8.49	8.49
Range	Minimum	8.26	8.25	8.26	8.26	8.25
	Maximum	8.64	8.62	8.67	8.68	8.66

The storage study conducted for developed sponge cake (from 0th day to 28th day of storage) at refrigeration temperature 4 ℃, it can be concluded that the average overall acceptability score for eggless sponge cake samples decreased during the storage period. The overall acceptability score was highest 0th Day with 8.66 followed by 7th Day (8.63), 14th Day (8.56), 21th Day (8.34) and 28th Day (8.25) contains lowest score for overall acceptability.

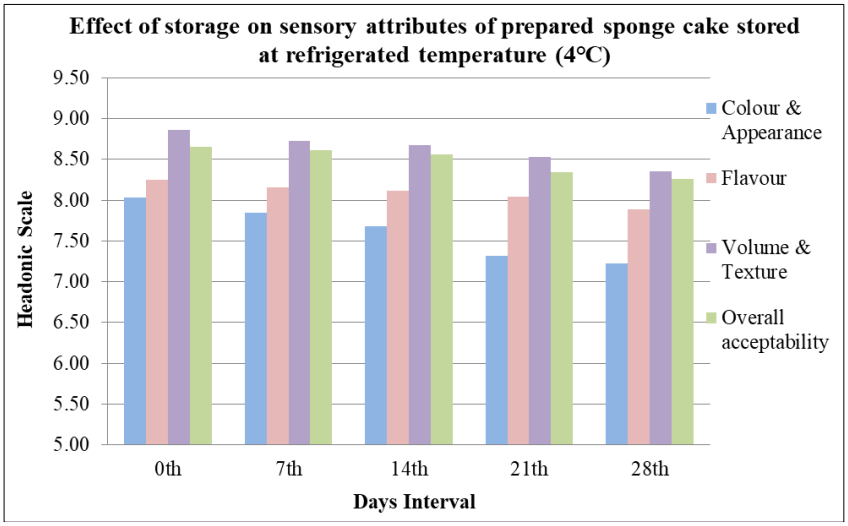

Fig 5: Graphical representation of sensory attributes of prepared sponge cake stored at refrigerated temperature (4 ℃)

Conclusions

The study was conducted to study the storage life of eggless sponge cake developed with treatment mix of whey protein concentrate and emulsifier gel, stored from 0th day to 28th day of storage at refrigeration temperature 4 ℃. The developed treatment combinations were subjected to physico-chemical, microbial and texture profile testing and achieved satisfactory results. Results shows that emulsifier gel formulated and standardized was effective and can be used to prepare eggless sponge cake.

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