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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(3): 759-762

www.thepharmajournal.com
Received: 26-01-2022
Accepted: 28-02-2022

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Process standardization of emulsifier gel and its effect on rheological, textural and baking properties of cake batter

Vyakhaya and John David

Abstract
The present research investigated three emulsifiers including Distilled Monoglycerides (DMG), Propylene Glycol Monostearate (PGMS) and Polysorbate -80 (P-80), which were used to develop a gel containing 28% of emulsifier, 20% of humectants (Propylene Glycol and glycerine) and 50% of water. 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. The evaluation of cake batters for batter density showed that the emulsifier gels decreased the batter density to 0.64 giving light weight and fluffy sponge cake. Results shows that the blend of emulsifiers used have interactively improved the overall properties of eggless sponge cake with minimum use of oils and fats in making.

Keywords: Emulsifiers, eggless cake, batter density

Introduction
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), 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) 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) [6].

Emulsifier
Baked goods have relied on emulsifiers for many years. The Miyamoto (2005) [9]. In their nature, these chemicals are lipophilic and hydrophilic. Chemical structure of emulsifiers allows them to concentrate in the oil/water interphase, which helps a thermodynamically unstable system become more stable. Because of their amphiphilic character and ability to form complexes with starch and proteins, emulsifying agents have a greater impact than their emulsifying capability. On the other hand, there are many different types of emulsifiers, each with a distinct chemical structure, which means that they may work in various ways and have varied effects on the dough and the bread as a whole (Goméz *et al.*, 2004).
Baking monoglycerides include plasticized, powdered, hydrated, and distilled varieties. All of them may be employed in a variety of ways. As an emulsifier for shortening and for the introduction of air into the lipid phase, alpha crystal monoglyceride emulsifiers are extensively employed in the making of cake batter. (Orthoefer 1997).

DMG (Distilled Monoglyceride)
Aeration and reducing the hardening of the crumb are the main reasons for using monoglycerides in cakes. Baking cakes requires the use of emulsifiers such monoglycerides, which must be activated during the batter beating process, which is similar to that used in breadmaking (Whitehurst, 2008) [16].

PGMS (Propylene Glycol Monostearate)
With its high fat solubility and capacity to interact with water in bakery applications, PGMS is

a good emulsifier for the creation of films with gel structures, as well as the improvement of aeration and foam stability, as the fats and water interact. (Sparso *et al.*, 2004).

P-80 (Sorbitan esters and polysorbates)

Sponge cake batter was made by whipping together eggs, sugar, and flour in an electric mixer. Due to the development of emulsifiers, the baking industry was able to use a single-stage mixing procedure in which all ingredients were combined and aerated by high-speed mixers. Sucrose monostearate and polysorbate 60, when combined with emulsified shortening, enhance the flavour of high-ratio cakes (including mono- and diglycerides). As the cake mixture is whipped, the gluten content decreases, making it easier for the cake to rise and bake evenly.Sorbitan monostearate in water with polysorbate 60 and other minor ingredients is used to make this product commercially. (Cottrell *et al.*, 2004).

Role of Emulsifier

In cakes, monoglycerides are being employed for three purposes: emulsion, aeration, and softening the crumb. Only when monoglycerides are in their active alpha crystalline state are they of any value. Approximately 5 to 10 degrees Celsius over their melting point, the monoglycerides are heated to achieve this. As a co-emulsifier, polyglycerol esters (PGE) are needed to retain monoglycerides in their active-phase state. Monoglycerides may also be found in margarine and shortening, which are utilized in the recipe. Stable distilled monoglycerides (DMG) in their crystallized state did little to improve the batter's aeration. It is necessary to extrude or spray dry emulsifiers on a carrier into powder before they can be utilized directly in baking applications. As a co-emulsifier, polyglycerol esters (PGE) are needed to retain monoglycerides in their active-phase state. Monoglycerides may also be found in margarine and shortening, which are utilized in the recipe. In 2004, Moonen and Bas (Moonen and Bas, 2004) [10].

Because of this, emulsifiers may be classified as either ionic or nonionic. It is the electrochemical charge of the emulsifier that determines the ionisation potential in water. They do not dissociate in water due of their covalent bonding structure, which is why they are nonionic emulsifiers (mono-, di-, and epoxylated monoglycerides, sucrose esters of fatty acids). It is not used in food since it is hazardous to the human body, even though cationic emulsifiers exist. Diacetyl tartaric acid esters of monoglycerides and sodium stearyl-2-lactylate are two examples of emulsifiers that may be anionic, however this is not the case in most food since they are poisonous to the body. This kind of emulsifier contains anionic and cationic groups in its surface-active capabilities, which are affected by pH."(Stampfli, 1995) [14].

Because of this chemical structure, emulsifiers may concentrate at the oil/water interphase and help stabilise a thermodynamically unstable system. Emulsifying agents' amphiphilic nature enables them to form complexes with starch and proteins, which enhances their emulsifying activity. On the other hand, the chemicals that make up emulsifiers have a totally different chemical structure, which leads to a wide range of methods of action and therefore diverse impacts on the dough and bread (Goméz *et al*., 2004).

Objectve

To standardize the process for formulating emulsifier gel mix by using different blend of emulsifiers with other ingredients

Materials and Methods

Ingredient Used: For the preparation of Emulsifier gel following ingredients was used:

Materials

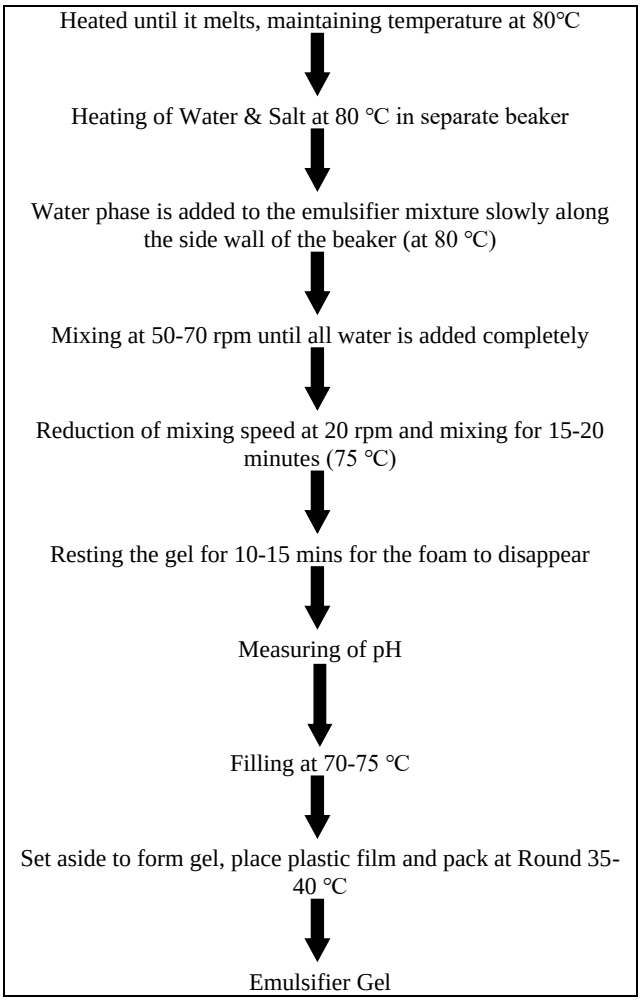
The raw ingredients for emulsifier gel were DMG (Fine Organics, India), PGMS (Fine Organics, India), Polysorbate-80 (Fine Organics, India), Propylene Glycol (Roquttee, India), Sorbitol (Roquttee, India), Potassium Stearate (Sankalp Organics, India), and Salt (Tata, India).

Formulation of Cake Emulsifier Gel: The Gel was formulated by using the different ingredients in the following proportion:

Formulation (Cake Gel)		
Ingredient	**Source**	**Quantity (%)**
DMG	Fine Organics, India	18
PGMS	Fine Organics, India	8
Polysorbate-80	Fine Organics, India	2
Propylene Glycol	Roquttee, India	15
Sorbitol	Roquttee, India	5
Potassium Stearate	Sankalp Org, India	1.8
Salt	Tata, India	.2
Water		50
Total		100

Flowchart for preparation of Emulsifier Gel

DMG, PGMS, P-80, Potassium Stearate, PG & Sorbitol is taken in a beaker



Flowchart for preparation of Emulsifier Gel

Final Product

Final Trial (Early Stage)	(After Set)
	

Cake Formulation

A standardized formulation based on preliminary lab trials was used for the study. Different trials were conducted by partial replacement of wheat flour and tapioca starch which was used as filler, it was observed that the best results were reported with 6 percent of WPC along with the emulsifier gel. The following formulation was used Refined wheat flour (g)-440, Powder Sugar (g)-400, Whey protein concentrate-80% (g)-60, Tapioca Starch (g)-10, Sodium Bicarbonate (g)-8, Salt (g)-5, Sodium Aluminium Phosphate (g)-10, Xanthan Gum (g)-1.5,Vanillin Flavour (g)-2.5, Emulsifier gel (g)-15, Fat/oil(g)-50, Water (g)-500. Dry ingredients are mixed and sifted well. The emulsifier gel along with water is mixed together in kitchen aid mixer at 45-50 rpm. Cake mix of all dry ingredients is added and mixed at slow speed initially at 50 rpm and gradually the speed of the mixer is increased to 150 rpm for 3 minutes. Now the oil is added at slow speed and the batter is mixed for one more minute. The cake batter is transferred to cake mould/tray and baked at 170-180 degree Celsius for 35-40 minute using Sinmag baking oven.

pH Measurement

Fifty grams of cake batter was mixed with 150 mL of distilled water and vortexed for 3 min for batter pH measurements. The mixture was held at room temperature for 30 min to separate solid and liquid phases. The pH of the batter was measured using digital pH meter SKU HI2002-02.

Batter Density

Batter density was measured by dividing the weight of a standard container filled with batter to the weight of the container filled with an equal volume of distilled water (Majzoobi *et al*. 2012) [8].

The Batter density of the cake batters was measured with a calibrated density cup of known volume. After mixing, the cup was filled to the brim with batter and weighed. The same procedure was performed using water. Batter density was determined gravimetrically by dividing the weight of the known volume of batter by the weight of an equal volume of water. Batter density was measured first during the mixing procedure (once per minute) to study its evolution and then, after the mixing procedure (after 3, 5, and 15 min at the highest speed [255 rpm]).

Texture analysis

Crumb texture was studied using a Texture Analyser (TA-XT2, India) which was interfaced with a computer to control the instruments and analyze the data. The analyzer was equipped with the software ‘‘Texture Exponent Lite’’. Cake slices (30× 30×30 mm), were cut from the center before being placed on the platform of the Texture Analyser. An Aluminum cylindrical probe of the diameter of 80 mm was made use of in a ‘‘Texture Profile Analysis’’ (TPA) test to compress the samples to 25% depth, at a pretest speed of 5 mm s-1, test speed of 0.25 mm s-1, time interval of 10 seconds. Hardness (peak force of first compression cycle), cohesiveness (ratio of positive areas of second cycle to area of the first cycle), springiness (the distance that the cake recovered in its height during the time that elapsed between the end of the first bite and the start of the second bite), the slope (gradient) of force-deformation curve and maximum force of the first bite of TPA test were estimated from the TPA curve and taken as indications of the crumb texture.

Table 2: Effect of emulsifier gel on the quality characteristics of sponge cake batter

Treatment Replication	Batter pH	Batter Density (g/cm3)	Hardness* (g)	Springiness (%)	Cohesiveness (%)	Total Score** (100)
R1	6.44	0.64	521.22	0.9	0.61	88.24
R2	6.43	0.63	521.21	0.91	0.61	95.63
R3	6.43	0.64	521.23	0.91	0.62	92.61
R4	6.44	0.64	521.22	0.9	0.62	94.25
R5	6.44	0.63	521.21	0.9	0.61	91.26
Mean	6.44	0.64	521.22	0.90	0.61	92.40

*****Cake crumb firmness measured using texture analyzer.

******Total score is a combined score of the following parameters: crumb cell uniformity (10), cell size (10), cell wall (10), grain (15), moistness (10), tenderness (10), softness (15), crumb colour (10), and flavour (10).

Effect of emulsifier gels on cake quality

Effect of emulsifier gels on quality of sponge cake batter and post baking results are presented in the above Table 2 states that the sponge cake developed was soft tender and moist. The major improvement in sponge cake was brought about by the combination of emulsifier used namely Distilled Monoglyceride (DMG)-18%, Propylene Glycol Monostearate (PGMS)-8%, Polysorbate-80 (P-80)-2%. pH and batter density are important parameters for cake batter and have direct impacts on overall cake quality in terms of texture, volume and appearance, the maximum average percent of batter pH was observed to be 6.44 because of the presence of leaveners in the cake mix. The batter density is a measure of amount of air incorporated in a batter during whipping process, Blend of emulsifiers help in incorporation of air in the batter also withhold it for longer time making the batter light and fluffy. The developrd sponge cake has the batter density of 0.64. Whereas, R. Jyotsna (2004) [6] reported batters containing emulsifier gels from sodium stearoyl–2–lactylate (SSL), distilled glycerol monostearate (DGMS), propylene glycol monostearate (PGMS), polysorbate–60 (PS–60), and Sorbitan monostearate (SMS) had a batter density of 0.86, 0.87, 0.88, 0.85, and 0.89 g/cm3, respectively. The crumb grain obtained from the cake was fine and uniform, whereas the crumb cell uniformity in the sponge cake was also even. The softness of the cake was evident from the

lowest hardness value received from the texture profile analysis with the average hardness of 521.22. Springiness measures elasticity by determining the extent of recovery between the first and second compression. The springiness value of sponge cake with emulsifier gel with maximum average of 0.90 whereas cohesiveness is the ability of a material to stick to itself. The cohesiveness values of sponge cake with emulsifier gel with maximum average of 0.61. The total score of the cake sponge was judged on different parameters like crumb cell uniformity, cell size, cell wall, grain, moistness, tenderness, softness, crumb colour and flavour with the total score of 92.40 (out of 100) and was overall acceptable.

Conclusions

The study concludes that the blend of emulsifier gel developed with 18% DMG, 8% PGMS and 2% P-80 have good potential towards the development of innovative bakery product with keeping in view of its superiority in quality and overall acceptability. Among the different treatment of 6% whey protein concentrate and 15% emulsifier gel used to develop eggless sponge achieved satisfactory outcome. The lighter batter with low batter density indicates decrease in batter concentration thereby leading to an increased cake volume with lighter product. Results shows that emulsifier gel developed and standardized was effective and can be used to prepare eggless sponge cake with higher aeration in the batter, enhanced volume and texture.

References

1. Al-Dmoor H. Production of cake from hard wheat flour. Will submit for publishing in Quality Assurance and Safety of Crops & Foods, 2012.
2. Bernard C, Regnault S, Gendreau S, Charbonneau S, Relkin P. Enhancement of emulsifying properties of whey proteins by controlling spray-drying parameters. Food Hydrocoll. 2011;25:758-763. doi: 10.1016/j.foodhyd.2010.08.011.
3. Brites CM, Trigo MJ, Carrapiço B, Alviña M, Bessa RJ. Maize and Resistant Starch Enriched Breads Reduce Postprandial Glycemic Responses in Rats. Nutr. Res. 2011;31:302-308.
4. Díaz-Ramírez M, Calderón-Domínguez G, Chanona-Pérez JJ, Janovitz-Klapp A, López-Santiago R, Farrera-Rebollo RR. Modelling sorption kinetic of sponge cake crumb added with milk syrup. International journal of food science & technology. 2013;48(8):1649-1660.
5. Gomez M, Ronda F, Caballero PA, Blanco CA, Rosell CM. Functionality of different hydrocolloids on the quality and shelflife of yellow layer cakes. Food Hydrocoll. 2007;21:167-173.
6. Jyotsna R, Prabhasankar P, Indrani D, Venkateswara Rao G. Improvement of rheological and baking properties of cake batters with emulsifier gels. J Food Sci. 2004;69:16-19.389-392.
7. Khalilian Movahhed M, Mohebbi M, Koocheki A, Milani E. The effect of different emulsifiers on the eggless cake properties containing WPC. Journal of food science and technology. 2016;53(11):3894-3903.
8. Majzoobi MAHSA, Hedayati S, Habibi MARYAM, Ghiasi FATEMEH, Farahnaky ASGAR. Effects of corn resistant starch on the physicochemical properties of cake. Journal of Agricultural Science and Technology, 2014;16(3):569-576.
9. Miyamoto Y, Sakamoto M, Maeda T, Morita N. Food Sci. Technol. Res. 2005;11:19-25.
10. Moonen H, Bas H. Mono-and diglycerides. Emulsifiers in food technology, 2004, 2.
11. Myhara RM, Kruger G. The performance of decolorized bovine plasma protein as a replacement for egg white in high ratio white cakes. Food Quality and Preference. 1998;9(3):135-138.
12. Shao YY, Lin KH, Chen YH. Batter and product quality of eggless cakes made of different types of flours and gums. Journal of Food Processing and Preservation, 2015;39(6):2959-2968.
13. Sparsø FV, Krog N. Propylene glycol fatty acid esters. Emulsifiers in Food Technology, 2004, 186.
14. Stampfli L, Nersten B. Food Chem. 1995;52:353-360.
15. Tubari E, Sammu G, Sahin S. Rheological properties and quality of rice cakes formulated with different gums and an emulsifier blend. Food Hydrocolloids. 2008;22:305–312.
16. Whitehurst RJ. (Ed.). Emulsifiers in food technology. John Wiley & Sons, 2008.