ISSN 2063-5346

DEVELOPMENT OF AN EGGLESS AMLA CAKE USING AQUAFABA VISCOUS LIQUID OBTAINED FROM COOKED CHICKPEA AS A SUBSTITUTE

Ramya H.N.[1], Nagendra N.S.[1], Hanumantharaju K.N.[2], Lavanya D[1*]

Article History: Received: 10.05.2023 Revised: 29.05.2023 Accepted: 09.06.2023

Abstract

The present investigation has been undertaken to develop an eggless amla cake by partial substitution of maida with oven-dried amla powder at different concentrations (control, 6%, 12%, 18%). The aquafaba viscous liquid extract obtained after cooking chickpeas is used as an egg substitute. The prepared product has been analyzed for physicochemical and sensory properties. The obtained results revealed that the eggless amla cake prepared by the incorporation of 18% amla powder showed better Physico-chemical properties in terms of crude fat (7.94%), crude ash (1.86%), crude fiber (0.910%), calcium (62 mg/100mg) with an overall calorific value of (379 Kcal). The cake formulated with 18% amla powder also showed better consumer acceptability with great retention of ascorbic acid of 320 mg/100g after baking. Hence the study concluded that 18% incorporation of amla powder using aqueous extracts of chickpea served as an eggless substitute.

Keywords: Amla powder, Chickpea, Eggless, Sensory evaluation, ascorbic acid.

[1]Department of Food Technology, Agriculture College, Hassan, Karnataka

[2]Department of Food Technology, RUAS, Bengaluru, Karnataka

[1]Vignan Foundation For Science Technology and Research, Guntur, AP

***Corresponding author Email:** drdl_ft@vignan.ac.in

DOI:10.48047/ecb/2023.12.9.03

1. Introduction

The cake is a baked, sweet confection prepared by mixing the ingredients like maida, butter or margarine, sugar, egg, baking powder, required flavor, and essence to make a smooth batter. After baking the texture of the obtained cake is spongy, with mouth-melting properties which are mainly due to the leavening agents especially egg and baking powder added in the formulation. Without the egg, the cake formulation will be sticky unacceptable texture and organoleptic properties. As mentioned, the cake is an artistic bakery product relished by all age groups. Around 90% of the population relishes cake all over the world. They are the modifications of bread, and can also be prepared in simple or elaborate varieties like pastries, meringues, custards, and pies (Aberathne, Navaratne, & Wickramasinghe, 2016).

On ceremonial events like weddings, anniversaries, and birthdays, the cake is frequently offered as a celebration food. There are innumerable cake recipes, many of which are years old. Some of them resemble bread, while others are lavish and intricate. While creating a cake once required a lot of labor (especially the whisking of egg foams), today's baking equipment and instructions are so simple that even the most inexperienced cooks may complete the task (Puranik & Gupta, 2017).

From recent studies, it has been estimated that around 1.5% of children and most of the population practicing a vegan diet are allergic to the eggs incorporated in cake formulations. In this perspective, much research has been carried out on replacing whey protein concentrate (Puranik & Gupta, 2017), plant-based substitutes like xanthan gum, coconut milk powder (Aberathne et al., 2016), Grass carp protein concentrate (Khan et al., 2020) were used as egg replacers. Also, to enhance the nutritional quality the cakes were fortified with amla powder mainly to increase the ascorbic acid content to overcome vitamin C deficiency among children as it contains around 206.8 mg to 932.1 mg/100 g (Alkandari, Sarfraz, & Sidhu, 2019). Amla due to its antiviral, antibacterial, and antioxidative properties is used as one of the principal constituents of the Ayurveda system of medicine for promoting eyesight, providing calm digestion, and preserving healthy hair. Additionally, it helps to improve immunity, cleanse the liver, control cholesterol, and cure diabetes. People are increasingly concerned about their health and looking for wholesome foods during this terrible circumstance, which is why eggless amla cake exists (Devi, Gupta, & Maurya, 2020). By considering the pros and cons of cake formulated with egg and fat which is nostalgic to certain age groups to combat lifestyle disorders like obesity and increased heart problems due to consumption of bakery products. The present investigation has been focused mainly to develop a cake formulated by replacing egg using aquafaba viscous liquid obtained after cooking chickpeas incorporated with the amla powder of 6, 12, and 18% as a part of fortification to induce the ascorbic acid content after baking.

2. Materials and methods

The raw materials required to carry out the present investigation like amla fruit to prepare amla powder procured from the farm of Agriculture College, Hassan, India, and other ingredients like maida, sugar, fat, baking soda, and equipment like cake mixer, oven for baking was utilized from the Department of Food Technology, Hassan, India.

Preparation of amla powder: Amla was cleaned and shredded. To reduce the moisture content of the grated amla to under 15%, it was dried using a variety of techniques, including direct solar drying, oven drying, microwave drying, and fluidized bed drying. The grated sample was equally distributed on the perforated

oven tray, which had been preheated to the necessary 65°C. The drying process was continued until the grated amla's moisture content was 15% or less. In a mixer grinder, the dry amla pieces were ground. The powder was then put through a sieve with a 65 mesh. The airtight container was sealed with dehydrated amla powder for storage.

Preparation of aquafaba: Around 500g of chickpeas was soaked in water overnight, followed by pressure cooking for 10 to 15 min. After cooking, the liquid should be separated from the chickpeas using a strainer. The obtained liquid extract should be boiled on a low flame for around 5 to 10 min for the removal of excess moisture. The aquafaba extracts were transferred to a clean glass jar and stored refrigerated for further use.

Cake preparation

In a basin, combine maida and amla powder. To stabilize aquafaba, combine it with cream of tartar, and then begin whipping. Turn the whip to low speed for a minute. The substance should start to froth. It will thicken after three to four min. Set the mixer on medium speed to lift the mixer and see gentle peaks forming after five to six min. The peaks will be stiffer after seven to ten min, though they might not appear exactly like whipped egg whites. The whipped aquafaba can now be combined with your other components. Add oil and icing sugar into the mixing bowl and continue beating until the batter appears glossy. To the batter add the mixture containing maida and amla powder and combine all the ingredients to prevent lumps. The baking is done batch-wise in a conventional oven at 180 °C for 30 min followed by cooling at room temperature. The prepared cake was packed in LDPE pouches and stored under ambient conditions. The formulations in the development of eggless cake have been presented in Table 1 and Fig 1 depicts the process flowchart for the cake preparation

Table 1: Formulation used for the preparation of Eggless amla cake with amla powder (AP)

Sl. No.	Ingredients	Control	T1 (6% AP)	T2 (12% AP)	T3 (18% AP)
1.	Maida (g)	100	94g	88g	82g
2.	Sugar (g)	90	90g	90g	90g
3.	Fat (g)	30	30g	30g	30g
4.	Baking soda (g)	3	3g	3g	3g
5.	Cream of tartar (g)	2	2g	2g	2g
6.	Aquafaba (ml)	100	100	100	100

Fig 1. Eggless cake substituted with aquafaba extract and AP.

Measurement of physical properties of the developed eggless cake

Specific gravity: The specific gravity of the batter has been measured as per the procedure followed by (Khan et al., 2020) by dividing the weight of a specific volume of batter by the same volume of distilled water.

Baking loss (%): Baking loss has been assessed as per the procedure followed by (Khan et al., 2020) in triplicates by using the formula:

$$BS\ (\%) = \frac{W_o - W_f}{W_o} \qquad \ldots(1)$$

Where BS: Baking loss

W_o = Weight of cake batter

W_f = Final weight of the cake after baking

pH

The sample preparation comprises mixing 10g of crushed cake powder in 100 ml distilled water to get a supernatant in triplicates. The pH of the supernatant is measured using a pH meter

Density

The density of the cake was determined in triplicates by measuring its weight by volume as per the procedure followed by

Proximate composition

According to the AOAC method, the moisture, fat, protein, ash, crude fiber, and carbohydrate content of the treated and control samples have been assessed in triplicates.

Ascorbic acid

The ascorbic acid in the prepared cake formulation has been assessed as per the procedure followed by slight modifications in triplicate. The procedure comprises of preparation of fresh ascorbic acid (AA) solution by dissolving 100mg of AA in 100ml distilled water in a volumetric flask. Pipette around 5ml of the sample with 1ml glacial acetic acid followed by the addition of 1ml chloroform and titrated against the dye solution until the color changes to pink. The obtained results were correlated by using the formula

$$\%AA = \frac{V_1 - V_3}{V_2 - V_3} \times W \times \text{dilution factor} \qquad \ldots(2)$$

Where, W= Weight of AA dissolved in 100ml of solution

V_1=Volume of dye solution absorbed with 5ml of the sample

V_2= Volume of the dye solution consumed with the standard AA

V_3=Volume of dye solution consumed in blank

Sensory evaluation

The prepared samples were evaluated for colour, flavour, texture and overall acceptability the by 7 trained panellists using 5-point hedonic scale as per the procedure followed by (Moraes et al., 2010). Sample with highest acceptability was awarded a score of 5 and 1 for the least acceptable.

Statistical analysis

The statistical analysis has been analyzed to know the significant difference between the treatments using Completely Randomized Design (CRD).

3. Results and discussion

Physical properties of the prepared cake

The physical properties of cake have been assessed and presented in table 1. It has been observed that the pH of the cake without the addition of amla powder was found to be 7.4±0.33, with the addition of 18% amla powder (T3) to the preparations the pH was reduced to 7.2±0.08. This significant ($p<0.05$) decrease in pH might be due to the increase in the ascorbic acid percentage in the cake. As the ascorbic acid percentage increases, the decrease in the pH has been visualised and the similar observations was recorded by (Khan et al., 2020). The prepared products exhibited a neutral pH. In a similar way, an increase in specific gravity of 0.98±0.01 followed by the baking loss of 11.4±0.13% has been noticed in the eggless cake formulated with 16% amla powder with not much significant ($p<0.05$) difference between the treatments. This might the consistency of the batter which seems to be heavier due to lack of aeration when amla powder is incorporated that indeed affected the baking quality. However, proper aeration is required for proper leaving of the batter. The similar findings have been recorded by (Paraskevopoulou, Donsouzi, Nikiforidis, & Kiosseoglou, 2015) while judging the quality characteristic of egg-reduced pound cake.

Table.1 Physical properties of the prepared eggless cake using aquafaba extract as an egg substitute.

Treatments	pH of the batter	Specific gravity	Baking loss
Control	7.40±0.33	0.958±0.04	13.08±0.59
T1	7.36±0.26	0.976±0.03	12.20±0.43
T2	7.30±0.19	0.978±0.02	11.45±0.30
T3	7.20±0.08	0.980±0.01	11.4±0.13
S.Em	0.138	0.009	0.235
CV	3.289	1.548	3.394
CD (5%)	0.451	0.028	0.766

Proximate composition of an eggless cake

The proximate composition of the prepared eggless cake compensated with aquafaba extracts have ±been analysed and presented in Table 2.

Table 2: Proximate composition of an eggless cake.

Treatments	Moisture (%)	Carbohydrates (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Ash (%)	Acid insoluble ash (%)	Energy (Kcal)
Control	13.69±0.63	69.71±3.19	7.10±0.33	7.22±0.33	0.80±0.04	1.78±0.1	0.04±0.00	372±17.05
T1	12.40±0.45	69.75±2.51	7.06±0.25	7.20±0.26	0.90±0.03	1.80±0.1	0.05±0.00	378±13.70
T2	12.56±0.33	69.84±1.85	7.04±0.19	7.16±0.19	0.90±0.02	1.84±0.0	0.05±0.00	378±10.00
T3	12.58±0.15	69.80±0.81	7.18±0.08	7.14±0.08	0.91±0.01	1.86±0.0	0.06±0.00	382±10.00
S.Em±	0.246	1.21	0.133	0.135	0.016	0.034	0.001	0.028
CV	3.338	3.265	3.28	3.277	3.176	3.229	2.98	2.906
CD (5%)	0.802	4.272	0.433	0.441	0.053	0.11	0.003	0.002

The moisture content of the treated samples was found to be less compared to the control sample (13.69±0.63%) followed by carbohydrate of 69.80±0.81% and crude protein content of 7.18±0.08% in T3 respectively. Also, T3 showed a less crude fat percentage of 7.14±0.08%, a crude fibre content of 0.91±0.01%, an ash and acid insoluble content of 1.86±0.0% and 0.06±0.00% compared to the control and other treatments However, there was no significant difference between the treatments has been noticed among the samples. On the other hand, acid soluble ash was same in both T1 (0.05±0.00%) and T2(0.05±0.00%) with no significant difference among the treatments. The highest energy value of 382±10.00 Kcal has been noticed in T3 (382±10.00) with the lowest energy value of 372±17.05 Kcal in the control sample. The variation in nutritional composition of the cake sample might be variation in the level of amla powder added in the preparations and the other properties like thickness, volume and baking loss may also affect the nutrient profile of the cake and the same has been noticed by (Khan et al., 2020) in eggless cake prepared by the incorporation of grass carp.

Ascorbic acid (AA)

The prepared eggless cake incorporated with amla powder at various percentage has been evaluated and presented in Fig 1. It has been observed that as the percentage of amla powder increases in the cake preparation, the AA of 320±3.69 mg/100g in T3, compared to the other samples. This might be the addition of amla powder of upto 18% led to the better retention of AA after baking compared to the other samples. The same variation in the AA in the prepared cake fortified with amla pomace after baking has been noticed by (Kohli, Aswal, Kumar, & Kumar, 2019) who suggested that the depletion of AA with respect to the baking time and temperature. However, by increasing the percentage of amla powder the level of AA after baking can be retained.

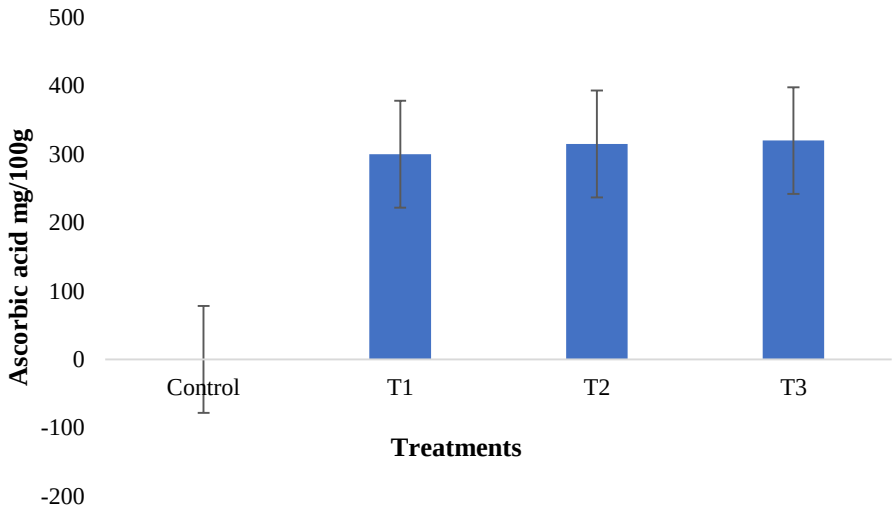

Fig. 2 Retention of AA in prepared eggless cake substituted with aqua faba extracts after baking

Sensory evaluation

The sensory evaluation for the prepared eggless cake samples substituted with aqua faba extracts and amla powder in varying percentages have been evaluated and presented in Fig 2. It has been observed that appearance of the prepared formulation scored 4 for control andT2 sample followed by a score of 3 in T1 and T3 respectively. In terms of taste and flavour control, T2 and T3 scored a highest value of 4. The texture of the control sample was found to be spongy, but after the incorporation of amla powder the texture was quit brittle. However, the overall acceptance has scored 4 for control, T1 and T4 samples compared to T3. It is also noticed that due to the incorporation of amla powder in various percentages have led to enhancement in ascorbic acid level and the same improvement in the nutritional level has been noticed by (Moraes et al., 2010) in cake prepared by the incorporation of flaxseed flour.

4. Conclusion

The use of Aquafaba as an egg replacer helps in development of Eggless cake. Amla powder is good source of ascorbic acid (481mg/100g) and mineral content (2.2 -3. 5%) can be used in the production of bakery products. The Eggless cake contains 18% Amla powder had better flavour, taste and overall acceptance when compared with the other sample cakes. The crude fat, crude ash, crude fibre content, calcium and ascorbic acid content were more in Eggless Amla Cake which contains 18%Amla powder. The retention of ascorbic acid 320 mg/100g after baking it's a good amount.

This study suggested that the Eggless cake prepared with Amla powder of 18% had comparatively better sensory and nutritional characteristics over control sample. Therefore, Eggless cake with 18% Amlapowder is advised to consume in our everyday diet for health benefits.

5. Acknowledgement

The authors would like to extent their heartfelt gratitude to the Dept. Of Food Technology, Vignan's Foundation for Scientific Technology and Research for providing the necessary facility to conduct the present investigation.

6. Conflict of Author(s)

There is no conflict of authors.

7. References

Aberathne, P., Navaratne, S., & Wickramasinghe, I. (2016). Development of ready to bake plant based cake mixture for vegetarians and egg allergens.

Alkandari, D., Sarfraz, H., & Sidhu, J. S. (2019). Development of a functional food (pan bread) using amla fruit powder. *Journal of food science and technology*, *56*(4), 2287-2295.

Devi, S., Gupta, E., & Maurya, N. K. (2020). Development of a value added Amla product.

Khan, S., Shehzad, Q., Ali, A., Rehman, A., Shah, H., Yang, F., . . . Xia, W. (2020). Development of Eggless Cake Using Grass Carp (Ctenopharyngodon Idella) Protein Concentrate and Its Quality Attributes. *Adv. Food Technol. Nutr. Sci*, *6*, 21-28.

Kohli, D., Aswal, P., Kumar, A., & Kumar, S. (2019). Effect of Baking Temperature on The Quality of Prepared Amla Pomace Biscuits. *Octa Journal of Biosciences*, *7*(2), 79-81.

Moraes, É. A., Dantas, M. I. d. S., Morais, D. d. C., Silva, C. O. d., Castro, F. A. F. d., Martino, H. S. D., & Ribeiro, S. M. R. (2010). Sensory evaluation and nutritional value of cakes prepared with whole flaxseed flour. *Food Science and Technology*, *30*, 974-979.

Paraskevopoulou, A., Donsouzi, S., Nikiforidis, C., & Kiosseoglou, V. (2015). Quality characteristics of egg-reduced pound cakes following WPI and emulsifier incorporation. *Food Research International*, *69*, 72-79.

Puranik, D., & Gupta, S. (2017). Development of egg-less cake using whey protein concentrate as egg substitute. *Int. J. Sci. Environ. Tech*, *6*(4), 2343-2352.