Effect of Incorporation of Carrot flour on Quality Characteristics of Cake

ABSTRACT

Cake is a form of food that is baked and usually sweet in taste. It provides fats, carbohydrates and body building protein.The aim of the present study was to develop carrot blended cake and to assess its quality characteristics during ambient storage conditions. For the development of carrot blended cake, refined wheat flour, whole wheat flour and carrot flour were blended in different proportions of T_1(100:0::RF:CF), T_2(90:10::RF:CF), T_3(80:20::RF:CF), T_4(70:30::RF:CF), T_5(100:00::WWF:CF), T_6(90:10::WWF:CF), T_7(80:20::WWF:CF) and T_8(70:30::WWF:CF) and were packed in high density polythene (HDPE) polythene pouches and stored at refrigeration conditions and subjected to quality characteristics at an interval of 7 days for a period of 21 days.The results showed that the phosphorus and iron content of cake decreased with an increase in storage period. No microbial count was detected in the fresh samples, but it increased with an increase in the storage period but was within the safe limits. On the basis of sensory evaluation (colour, texture, taste and flavour) of carrot blended cake, treatment T_3 (**(80:20::RWF:CF)**) was adjudged to be the best among all the treatments with mean score of colour(8.26), texture (8.15), taste (8.12) and flavour (8.05), respectively.

Keywords: Carrot, cake, refined wheat, whole wheat, sensory evaluation, mineral composition

1. INTRODUCTION

Carrot (*Daucuscarota* L.) is an important vegetable crop grown all over the world for its enlargedtap roots and belongs to family Apiaceae. It is grown during spring, summer and autumn in temperate climate and during winter in tropical and subtropical climate (Thakur and Jamwal, 2012).Carrots are healthy vegetables, but this agricultural product has low value when they are sold as a raw commodity. To become value-added agricultural products, the value of raw carrots has to be increased through the addition of ingredients or processes that make them more attractive to the buyer. Increasing the added value of the carrots requires the development of food products that considering the voice of the customer (Meister and Kava, 2006). Its maximum retention is of outmost importance for the preservation of the attractive appearance and dietary value of the product. Carrots have a moisture content of 80– 90% (wet basis) at the time of harvest. They are seasonal in nature and highly susceptible to moisture loss leading to wilting and loss of fresh appeal (Rafiq*et al*. 2023). Wheat flour is one of the important cereal grain because of its use for the preparation of many baked products. Bakery products are mostly

prepared from refined wheat flour with 60-75% extraction rate, which has still lower nutritive value. However, such products can easily be enriched and fortified at lower cost with proteins, fibre, various vitamins and minerals to meet the specific need of the target groups and vulnerable sections of the population who are undernourished and malnourished (Chopra *et al.*, 2013). Cakes are the most popular bakery products worldwide especially among children, they love to eat cakes, cupcakes and biscuits. Cake is a complex of fat and water emulsion system containing flour, fat, sugar, baking powder and baking soda. A proper combination of the ingredients can give a high-quality product with desirable flavour and texture (Singh *et al*., 2022). The incorporation of carrot flour in cake may improve its nutritive value, lower the cost and help in enhancing the utilization of carrot.

2. MATERIAL AND METHODS

Refined wheat flour and whole wheat flour were substituted with different percentage of carrot flour*i.e*100:0, 90:10, 80:20 and 70:30 for the preparation of blended cake. The batter was thoroughly mixed by adding required amount of all ingredients. After mixing, the batter was filled in moulds containing pan. The cake pan was placed in baking tray smeared with fat and baked at 180^0C for 30 min in baking oven/deck oven. After baking, the cakes will be cooled and packed airtight in high density polythene (HDPE) and kept in refrigerator for storage. The stored product was analyzed for quality and organoleptic characteristics at a regular interval of 7 days. The mineral content was estimated as per the procedure described by AOAC (2007). As per the procedure coined by Amerine*et al.* (1965), score of 5.5 and above was reflected as acceptable. The experiment was laid out in factorial CRD with nine treatments and replicated thrice. The data obtained were statistically analysed as per the procedure of Gomez and Gomez (1984) using OPSTAT software.

3. RESULT AND DISCUSSION

Minerals (phosphorus and iron)

During the storage of 21 days, phosphorus and iron content of different treatments revealed that the mean phosphorus and iron content of carrot blended cake significantly decreased from the initial level of 186.13 to 185.04 mg/100g and 2.47 mg/100g to 1.95 mg/100g, respectively (Table 1). Maximum mean phosphorusand iron content of 194.08 mg/100g and 2.60

mg/100gwere recorded in T_5 (100:0::WF:CF) whereas minimum of 177.41 mg/100g and 1.75 mg/100gwere recorded in the treatment T_4 (70:30::RWF:CF), respectively. The resultsare in conformity with the findings of Pandey (2015) and Singh (2021). The decrease in minerals might be due to its heat sensitivity, even at ambient temperature which leads to destruction of minerals in cake during the storage period. Similar findings were reported by Anu*et al*. (2008) in banana blended cake, Olatunde*et al*. (2019) in pigeon pea, sweet patoto and wheat flour cake and Pandey *et al.* (2024) in carrot powder incorporated bread.

Microbial load

A glance of data in table 2 showed the effect of various treatments and storage on microbial load of cake. However, the microbial loads of the cake samples observed to be on the increase from day 7 to 21 days. The values obtained for cake samples were within the acceptable international commission on microbiological specification (ICMSF) limits and recommendation for products of this nature (10^5cfu/g) in good manufactured practice (ICMSF, 2009). Similar trend of microbial count during storage period was reported by Singh *et al*. 2022 in pearl millet cake.

Colour

A significant reduction in colour scores was recorded during 21 days of storage (Table 3). The mean values of colour scores showed a reducing trend from initial level of 7.91 to 7.36 with the advancement in storage. The resultsare in accordance with the findings of Ghodke and Kale (2017), Mittal (2018) and Khalaf (2024). Among treatments, highest mean colour score of 8.26 was noticed in treatment T_3 (80:20::RWF:CF) while the lowest score of 7.04 was noticed in T_5 (100:0::WF:CF). The decrease in colourscore of the product during storage might be due to browning reaction which could have resulted from non enzymatic oxidation of ascorbic acid.Sahni (2015)and Shende (2016) also reported decline in colour scores during storage while preparing carrot based cookies and value added sponge cake, respectively.

Texture

From the data in Table 3, it was evident that there was decrease in the texture score of carrot blended cake with the progress in the storage period. Among treatments maximum mean texture score of 8.15 was reported in cake prepared with 80% refined wheat flour and 20% carrot flour (T_3) whereas minimum score of 6.85 was reported in the T_5 (100:0::WF:CF). The results are in harmony with the findings of Anu*et al*. (2008), Ghodke and Kale (2017) and Baltacıoğlu*et al.* (2019) who reported decreasing trend in texture score in banana blended cake, carrot-brahmibased biscuits and cookies incorporated with carrot powder, respectively. Maximum mean texture score was recordedat beginning of storage (7.81) while the minimum was recorded after 21 days of storage (7.29). The decrease in quality score of texture was mainly due to the absorption of moisture that has negative effect on texture.Similar observations were also supported by Sahni (2015) in carrot blended cookies and Khalaf (2024) in red carrot powder blended cake.

Taste

The experimental values of taste scores under different treatments and storage were presented in Table 4. Maximum mean taste score (8.12) was observed in T_3 (80:20::RWF:CF), whereas the minimum (6.83) was scored in T_5 (100:0::WF:CF). The mean taste scores showed a declining trend with the progress in storage period from 7.80 to 7.21. The results are consistent with those of Baltacıoğlu*et al*. (2019) and Khalaf (2024) who studied the different attributes of carrot blended cookies and carrot powder blended cake, respectively. Taste was found to be affected probably due to lipolytic changes, hastened by increase in the moisture content of cake (Butt *et al*., 2007). Thedeclineintastescoresduringstorage might also bedue tooxidation offats(freeandunsaturatedfattyacids)leading torancidity. The results are in accordance with the observations of Sahni (2015), Agrawal *et al*. (2017),Soni (2019)and Sule*et al*. (2019).

Flavour

The data pertaining to flavour scores of carrot blended cake was presented in Table 4. Among treatments highest mean flavour score was recorded in treatment T_3 (8.05), whereas lowest mean flavour score was recorded in (T_5) 100% wheat flour cake (6.71). Maximum mean

flavourscorewas observed during initial days of storage (7.75) and minimum was observed after 21 days (7.12) of storage. These results are concurred with the findings of Sahni (2015) and Ghodke and Kale (2017). This gradual decline in flavour scores might be due to certain enzymatic, physiological or biochemical changes. Mahmood *et al*. (2008) reported that the decrease in flavour score as a function of storage might be due to oxidation of fats and maillard reaction. Similar findings were observed by Salehi*et al*. (2015) while preparing sponge cake with air dried carrot and Pragya (2018) whiledeveloping various functional food using carrot.

CONCLUSION

Cake can be prepared by using 80 per cent refined flour and 20 per cent carrot flour as the optimum proportion to produce the acceptable cake. The use of carrot flour improved the nutritional quality of cake with respect to phosphorus and iron content. On the basis of sensory evaluation (colour, texture, taste and flavour), treatment T_3 (80:20:: refined wheat flour: carrot flour) was found to be the best treatment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE): Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTEREST

Authors have declared that no competing interests exist.

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Table 1: Effect of treatment and storage period on phosphorus and iron of carrot blended cake

Treatments	Phosphorus (mg/100g)				Mean (Treatment)	Iron (mg/100g)				Mean (Treatment)
	Storage period (Days)					Storage period (Days)				
	0	7	14	21		0	7	14	21	
T_1 (100:0::RWF:CF)	185.21	184.89	184.46	184.15	**184.68**	2.82	2.59	2.45	2.28	**2.53**
T_2 (90:10::RWF:CF)	182.79	182.46	182.02	181.67	**182.23**	2.57	2.30	2.18	2.04	**2.27**
T_3 (80:20::RWF:CF)	180.47	180.18	179.74	179.40	**179.95**	2.32	2.08	1.94	1.82	**2.04**
T_4 (70:30::RWF:CF)	177.95	177.63	177.21	176.86	**177.41**	2.06	1.80	1.63	1.51	**1.75**
T_5 (100:0::WWF:CF)	194.62	194.29	193.88	193.54	**194.08**	2.89	2.65	2.49	2.36	**2.60**
T_6 (90:10::WWF:CF)	191.70	191.37	190.95	190.62	**191.16**	2.63	2.41	2.26	2.14	**2.36**
T_7 (80:20::WWF:CF)	189.34	189.06	188.61	188.30	**188.83**	2.38	2.12	1.98	1.85	**2.08**
T_8 (70:30::WWF:CF)	186.97	186.64	186.19	185.82	**186.40**	2.10	1.87	1.69	1.57	**1.81**
Mean (Storage)	**186.13**	**185.81**	**185.38**	**185.04**		**2.47**	**2.23**	**2.08**	**1.95**	
Effects	**C.D. $_{(p=0.05)}$**					**C.D. $_{(p=0.05)}$**				
Treatment (T)	0.06					0.01				
Storage (S)	0.04					0.01				
T × S	0.13					0.03				

Table 2: Effect of treatment and storage period on microbial load of carrot blended cake

Treatments	Microbial load			
	Storage period (Days)			
	0	7	14	21
T_1 (100:0::RWF:CF)	ND	1.06	1.22	1.43
T_2 (90:10::RWF:CF)	ND	0.97	1.16	1.30
T_3 (80:20::RWF:CF)	ND	0.85	0.94	1.03
T_4 (70:30::RWF:CF)	ND	0.62	0.78	0.95
T_5 (100:0::WWF:CF)	ND	1.12	1.26	1.48
T_6 (90:10::WWF:CF)	ND	0.99	1.18	1.34
T_7 (80:20::WWF:CF)	ND	0.88	0.97	1.05
T_8 (70:30::WWF:CF)	ND	0.65	0.80	0.97

Table 3: Effect of treatment and storage period on colour and texture of carrot blended cake

Treatments	Colour				Mean (Treatment)	Texture				Mean (Treatment)
	Storage period (Days)					Storage period (Days)				
	0	7	14	21		0	7	14	21	
T_1 (100:0::RWF:CF)	7.45	7.27	7.08	6.87	**7.17**	7.34	7.19	7.02	6.88	**7.11**
T_2 (90:10::RWF:CF)	7.83	7.64	7.43	7.25	**7.54**	7.76	7.57	7.40	7.21	**7.49**
T_3 (80:20::RWF:CF)	8.56	8.33	8.17	7.99	**8.26**	8.41	8.23	8.06	7.90	**8.15**
T_4 (70:30::RWF:CF)	8.18	8.02	7.83	7.62	**7.91**	8.10	7.92	7.74	7.55	**7.83**
T_5 (100:0::WWF:CF)	7.29	7.14	6.95	6.78	**7.04**	7.14	6.91	6.77	6.59	**6.85**
T_6 (90:10::WWF:CF)	7.67	7.51	7.32	7.11	**7.40**	7.55	7.38	7.23	7.04	**7.30**
T_7 (80:20::WWF:CF)	8.35	8.20	8.05	7.87	**8.12**	8.27	8.12	7.94	7.72	**8.01**
T_8 (70:30::WWF:CF)	7.92	7.76	7.59	7.38	**7.67**	7.95	7.78	7.59	7.44	**7.69**
Mean (Storage)	**7.91**	**7.73**	**7.55**	**7.36**		**7.81**	**7.64**	**7.47**	**7.29**	
Effects	**CD $_{(p=0.05)}$**					**CD$_{(p=0.05)}$**				
Treatment (T)	0.03					0.02				
Storage (S)	0.02					0.01				
T × S	0.06					0.04				

Table 4: Effect of treatment and storage period on taste and flavour of carrot blended cake

Treatments	Taste				Mean (Treatment)	Flavour				Mean (Treatment)
	Storage period (Days)					Storage period (Days)				
	0	7	14	21		0	7	14	21	
T_1 (100:0::RWF:CF)	7.37	7.18	7.00	6.78	**7.08**	7.30	7.07	6.86	6.69	**6.98**
T_2 (90:10::RWF:CF)	7.75	7.57	7.34	7.16	**7.46**	7.69	7.45	7.27	7.11	**7.38**
T_3 (80:20::RWF:CF)	8.38	8.24	8.02	7.85	**8.12**	8.37	8.14	7.93	7.76	**8.05**
T_4 (70:30::RWF:CF)	8.06	7.89	7.67	7.43	**7.76**	8.05	7.89	7.66	7.43	**7.76**
T_5 (100:0::WWF:CF)	7.13	6.95	6.74	6.51	**6.83**	7.03	6.80	6.61	6.39	**6.71**
T_6 (90:10::WWF:CF)	7.59	7.41	7.22	6.98	**7.30**	7.48	7.29	7.05	6.82	**7.16**
T_7 (80:20::WWF:CF)	8.20	8.04	7.83	7.64	**7.93**	8.23	8.02	7.79	7.58	**7.90**
T_8 (70:30::WWF:CF)	7.93	7.78	7.55	7.32	**7.64**	7.86	7.64	7.41	7.22	**7.53**
Mean (Storage)	**7.80**	**7.63**	**7.42**	**7.21**		**7.75**	**7.54**	**7.32**	**7.12**	
Effects	**CD $_{(p=0.05)}$**					**CD $_{(p=0.05)}$**				
Treatment (T)	0.02					0.04				
Storage (S)	0.01					0.02				
T × S	0.03					0.07				