



Consumer preference on cakes, acceptability and nutritional evaluation of food fortified cakes

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ARTICLE INFO

Article history:

Received: 23 November 2013;

Received in revised form:

25 November 2013;

Accepted: 13 January 2014;

Keywords

Micronutrient,
Fortified Cakes,
Lotus stem,
Carrots.

ABSTRACT

Micronutrient malnutrition affects almost two billion people worldwide and food fortification is considered as a major cost effective and sustainable solution. To enhance the micronutrient content of cakes by food fortification using locally available under exploited but nutritionally rich indigenous food fortificants. Lotus stem and Carrots were chosen as food fortificants. The nutrient analysis of the fortificants was carried out. Lotus stem powder (LS) and carrot powder (CA) were incorporated individually (15, 20 and 25 percent) as well as in mixed form (MF) (2:1, 1:1, 1:2.) in Chocolate (CH) and Orange cake (OR) and the highly acceptable cakes were analyzed for iron, β carotene and quality parameters. Lotus stem powder had iron (80mg/100g), β carotene (543 μ g/100g) and fibre (31.6 g/100g). Carrot powder had iron (5 mg/100g), β carotene (6875 μ g/100g) and fibre (1.46g/100g). Among all the variations LSCK₂ (84.5 percent), CAOR₁ (84 percent) MFCK₁ (88 percent) and MFOR₁ (87.3 percent) cakes were highly acceptable. LSCK₂ had the highest iron content (12.50mg/100g) and CAOR₁ (760 μ g/100g) had highest β carotene content. Total solids were above the standard value of 60 percent. pH of MFCK₁ and MFOR₁ were 6.2. The microbial count of the cakes was found to be within the satisfactory limit. Conclusion: Fortification of cakes is a possible venture to alleviate micronutrient malnutrition in people.

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Introduction

Food security is often conceptualized in the context of food energy or calorie intake. However, it is increasingly recognized that a large segment of the world's population especially in developing countries are consuming food that is deficient in micronutrients like vitamin A and iron etc. (Vaclavik and Christian, 2008). The manifestations of such micronutrient deficiencies are vitamin A deficiency syndrome, night blindness, xerophthalmia, anemia, goiter etc. In communities living in developing countries, prevalence of poor diet and infectious disease unite into a vicious circle. Moreover, they are most important risk factors for illness and death, affecting millions of pregnant women (Muller and Krawinkel, 2005). Diet based strategies are considered to be one of the most efficient and sustainable ways to overcome iron and vitamin A deficiencies. Fortification of bakery products is given priority in recent times as more number of bakery items are liked and consumed by quite a number of people. Cake is an ideal vehicle for fortification as it is a popular snack or dessert of all age groups especially children and adolescents. As cakes are soft in texture it is suitable for old people to consume without any difficulty of chewing. Cakes are fun to eat and are consumed in events such as social gatherings, party, seminar, or during a family gathering as they have better appeal, taste, satiety and convenience, however they are low in micronutrient content but high in fat. Hence, fortification using locally available under exploited yet nutritionally rich food is a good means of enhancing the micronutrient content of cakes.

Materials and methods

A questionnaire was formulated and given to Adult volunteers of age group of 20-35 years to know the consumer preference in cakes. Lotus stem (*Nelumbium nelumbo*) and Carrot (*Daucus carota*) were chosen as food fortificants for

iron and β carotene respectively. Lotus stem was purchased from a village called Kadathampatty near Pudukottai and carrots were procured freshly from the local market. After preliminary preparations the edible portions of lotus stem was cut into fine round shaped pieces and the edible portions of carrots were sliced, blanched for two to seven minutes using hot water to inactivate the native enzymes and cooled. Both the fortificants were dehydrated by oven drying, and were ground into powder (plate 1 and 2) and stored in High Density Polyethylene (HDPE) covers for further use. Proximate analysis of moisture, ash, iron, crude fibre and protein were estimated according to the methods prescribed in NIN (2003). β carotene and vitamin C were determined using standard procedures by Ranganna (2008) for the prepared fortificants.

Plate 1
Lotus stem powder



Plate 2
carrot powder



Product development

Lotus stem powder and carrot powder were incorporated at three levels viz 15 20 and 25 percent in both chocolate cake (LSCK) and orange cake (CAOR). A standard chocolate and orange cake were prepared as control as per the standard

procedure given by **Abby Merrill Adams (2009)** Lotus Stem powder and Carrot powder were mixed in three different proportions viz. 2:1, 1:1, 1:2 and incorporated into chocolate and orange cake and were designated as MFCK and MFOR respectively. The different formulations of the food fortified cakes are given in **Table 1**.

Table 1. Different variations used to prepare food fortified cakes

Cake	Samples	Percentage of incorporation of	
		Lotus stem powder	Carrot powder
Chocolate cake	LSCK ₁	15	-
	LSCK ₂	20	-
	LSCK ₃	25	-
Orange cake	CAOR ₁	-	15
	CAOR ₂	-	20
	CAOR ₃	-	25
Chocolate cake	MFCK ₁	15	5
	MFCK ₂	10	10
	MFCK ₃	5	15
Orange cake	MFOR ₁	15	5
	MFOR ₂	10	10
	MFOR ₃	5	15

LS- Lotus stem

CK- Chocolate cake

CA- Carrot

OR- Orange cake

MF- Mixed fortificants

Organoleptic evaluation

The prepared cake samples were evaluated periodically (1st, 3rd, 5th day) of storage by 20 semi trained volunteers. Cakes were served to each volunteer separately and they were asked to score individually without any discussion to avoid bias. It was ensured that not more than three variations were kept for sensory evaluation on single day to prevent "taste fatigue" bias.

Quality assessment and nutrient analysis

Total solids, acid insoluble ash, pH, and crude fibre were analyzed using Bureau of Indian Standard **IS:1483-1988(2010)**. The iron and β carotene content of the control and fortified cakes were analyzed using standard procedures.

Shelf life and microbial count in fortified cakes

The determination and level of bacterial contamination in food helps one in allows assessing the shelf life of food and mode of storage **Ranganna (1986) and Manja and Sankaran, 1994)**. The cakes were observed for mold growth every 24 hours for a period of seven days to determine the shelf life and Microbial count was done using serial dilution plating technique on first, third and fifth day of preparation.

Cost effect ratio

The Cost effect ratio was calculated using the cost of each ingredient in the local market to ascertain the consumers purchasing power.

Results and discussion

Consumer preference on cakes

Chocolate cake (29 percent), flavoured and nuts cake (24 percent), plain flavoured cake (23 percent) and sponge cake (20 percent) were preferred by the respondents. Highest preferred flavour was chocolate (52 percent) and the least preferred was strawberry (10 percent). One third (33.3 percent) of the respondents liked to buy cakes in exclusive cake shops. Over half of the participants (51 percent) consumed cakes whenever they feel like. Heart shaped cakes (30 percent), round shaped (26 percent), Square (24 percent) and rectangle (15 percent) cakes were the commonly purchased cake shapes. Chocolate glaze icing was the most liked (68 percent) icing. 76 percent had not

reported allergic reaction after eating cakes. 56 percent of respondents had no idea about the nutritional value of cakes.

Nutrient content of selected fortificants

The nutrients content of the fortificants like moisture, ash, iron, β carotene, crude fibre, protein and vitamin C are given in table 2.

Table 2. Nutrient content of fortificants

Fortificants Nutrients	Moisture (percent)	Ash content (g percent)	Iron (mg)	β carotene (μ g)	Crude fibre (g)	Protein (g)	Vitamin C (mg)
Lotus stem powder	9.8 (9.3)	6.4	80 (60.6)	543 (0)	31.6 (25)	4 (4.1)	2 (3)
Carrot powder	5.5 (4.9)**	5.4	5 (1.03)	6875 (6460)	1.46 (1.2)	1 (0.9)	2 (3)

* Figures in parenthesis indicate the standard values (**ICMR, 2007**)

** **Abid and Ali, 2008**

Organoleptic evaluation

Among the lotus stem fortified cakes (**plate 3**) LSCK₃ got the highest score for colour and appearance on "Day one" (4.8 \pm 0.41) and "Day three" (4.6 \pm 0.50). On "Day one" LSCK₂ got the maximum score (4.5 \pm 0.68) for texture. All the cakes tasted best on "Day one". The pronounced cake flavour was observed in LSCK₂ and LSCK₃ on "Day one" and "Day three". 20 percent lotus stem fortified cake was the best with 84.5 percent acceptability among all variations. LSCK₂ which received the 20 percent incorporation of lotus stem powder was adjudged the best by the panelist with 83.5 percent in all sensory parameters viz. colour, texture, taste and flavour on different days of storage.

The colour and appearance of all the cakes fortified with carrot powder (**plate 4**) had good score on all three days of storage. On "Day one", CAOR₃ got the maximum score for texture (4.45 \pm 0.51). The fresh cakes tasted excellent on "Day one" and the scores ranged from 4.1 \pm 0.64 (CAOR₂) to 4.45 \pm 0.51 (CAOR₁). On all the three days of evaluation CAOR₁ obtained the highest score for flavour. 15 percent carrot powder fortified cakes (CAOR₁) obtained the highest acceptability percentage (88 percent).

In mixed fortified chocolate cakes (**plate 5**); MFCK₁ was soft and spongy on all three days of storage. Gradual deterioration was observed in taste scores of all cakes on storage. MFCK₁ had similar score for flavour (4.1) on "Day one" and "Day three". Overall acceptability of all the mixed fortified chocolate cake gradually declined from "Day one" to "Day five". MFCK₁ (15 percent lotus stem powder and 5 percent carrot powder incorporation) was the best among mixed fortified cakes.

Mixed fortified orange cake (**plate 6**) had good colour and appearance compared to control orange cake. MFOR₁ got the highest score for flavour on "Day one" (4.3 \pm 0.65) and "Day three" and "Day five" (4.05 \pm 0.68). MFOR₁ cake was rated as the best by the taste panelists.

Plate 3 Lotus Stem Fortified Cakes **Plate 4** Carrot Powder Fortified Cakes



Plate 5
Mixed fortified chocolate cakes

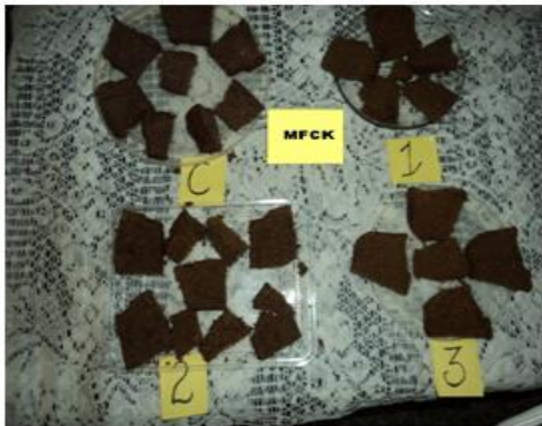


Plate 6
Mixed fortified orange cakes



Iron and β carotene content of food fortified cakes

The iron content (Figure 1) of the most organoleptically accepted and approved fortified cakes were analyzed soon after preparation and on the fifth day of storage. Iron content of cakes showed considerable improvement on fortification. The chocolate and orange cake (control) contained just 3.50mg/100g of iron. Cakes fortified with 20percent lotus stem powder (LSCK₂) showed the highest value of iron content (12.50mg/100g). Both the chocolate and orange cake (control) showed a similar β carotene content of 534 μ g/100g. Cakes fortified with 15 percent carrot powder (CAOR₁) registered the highest amount of β carotene i.e., 760 μ g/100g among all the variations. There was no loss in both iron and β carotene content of cakes on storage period. This shows that these fortificants could be effectively used to enhance the iron and β carotene content of food products.

Figure 1

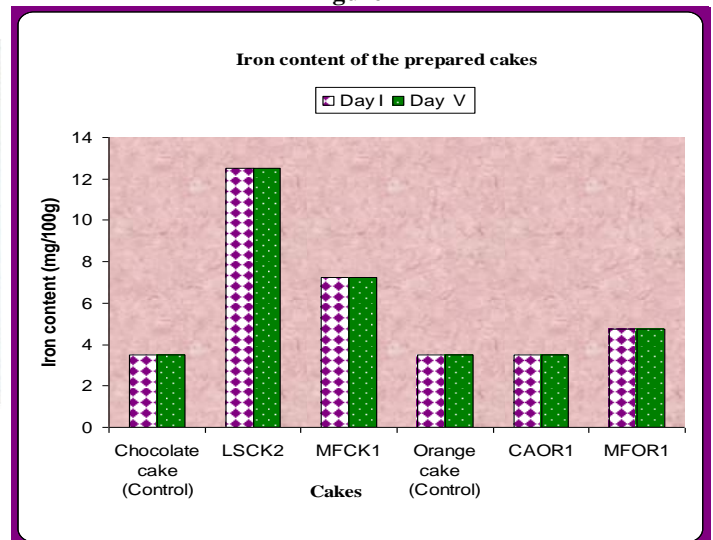
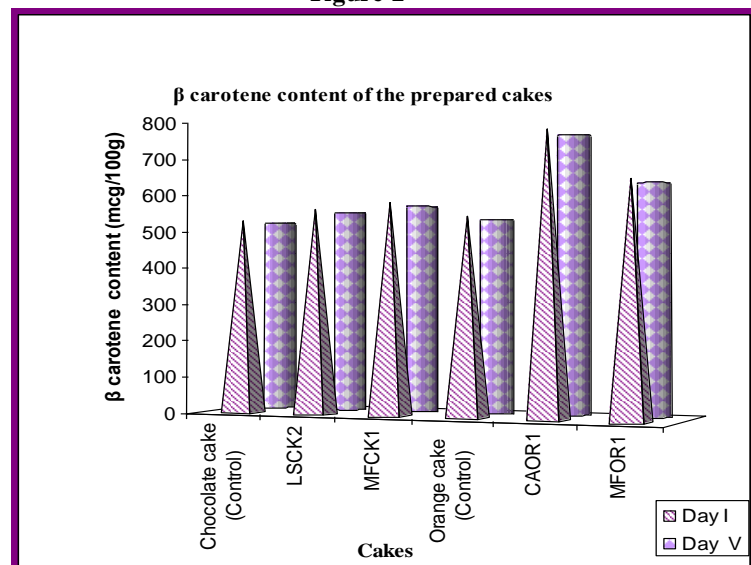


Figure 2



Quality characteristics of the food fortified cakes

Moisture

Cauvain and young (2006) had specified a standard moisture content for chocolate cakes as 18-28g percent and white cakes 26-34 percent. In the present study the moisture content of chocolate cakes ranged from 31.4 (MFCK₁ on "Day five") to 35 (control chocolate cake on "Day one"). These values are little higher than the above quoted standard value. Orange cake of the present study showed a moisture content of 31.1(MFOR₁ ON "Day five") to 34 (control orange cake on "Day one"). So the present values are within the limits given above. It is clear from the above that the moisture content of cakes reduces as storage period increases. This only indicates that moisture loss is a continuous process in prepared cakes and should be arrested by enhanced packing measures.

Total solids

Total solids are a measure of the amount of material remaining after all the water has been removed. Bureau of Indian Standards (BIS), 2010 had specified a minimum of 60 percent total solid content for White bread. In the present analysis all the highly acceptable fortified cakes contained considerable total solids ranging from 65 g percent (Chocolate cake- control) to 67.5 percent (MFCK₁) that are well above the BIS value. A simultaneous decrease in moisture content was also noticed as discussed earlier.

pH

The relative acidity or alkalinity of the substances is conveniently expressed as pH. Most of the highly acceptable cakes had a low acidity and it was from 5.5 to 5.8 as against the standard value (BIS) of 5.0 to 6.0.

Crude fibre

The maximum permissible crude fibre content as per Bureau of Indian Standards (BIS, 2010) is 0.5g percent. Orange cake control had the least crude fibre (0.006g percent) whereas LSCK₂ had the highest (0.039 g percent). Crude fibre content of all the highly acceptable cakes was within the permissible level as specified by BIS.

Acid insoluble ash

Bureau of Indian Standards have given an allowance of 0.1g percent (acid insoluble ash) on dry basis. In the present analysis except the mixed fortified cakes (MFCK₁ and MFOR₁) all the other four cakes did not have any acid insoluble ash thus indicating the absence of non edible matters such as sand or dirt. Even the two mixed fortified samples that had very low (0.03g percent) acid insoluble ash and within the permissible limits of BIS.

Microbial count and Shelf life of fortified cakes

Gilbert et al. (2000) had given a guideline for the microbial quality of Ready to Eat Foods. According to this the satisfactory limit of microbial count is $<10^5$. In the present study the microbial count of all days was lower than the above quoted standard (table 3). The present study revealed that the control as well as the fortified samples remained fresh without any mold growth up to five days.

Table 3. Microbial count of cakes during storage period

Cakes	Days		
	Day I	Day III	Day V
Chocolate cake (Control)	10	14	20
Orange cake (Control)	9	12	19
LSCK ₂	11	13	19
CAOR ₁	12	14	20
MFCK ₁	15	20	27
MFOR ₁	16	20	28

* BIS- Bureau of Indian Standards (2010)

Cost-Effect ratio

Chocolate cake (control) and orange cake (control) costs ₹ 28.17 and ₹ 21.92 respectively. There was not much difference in cost of cakes when lotus stem powder and carrot powder were incorporated which is clearly evident from the figure 3 and 4.

Figure 3

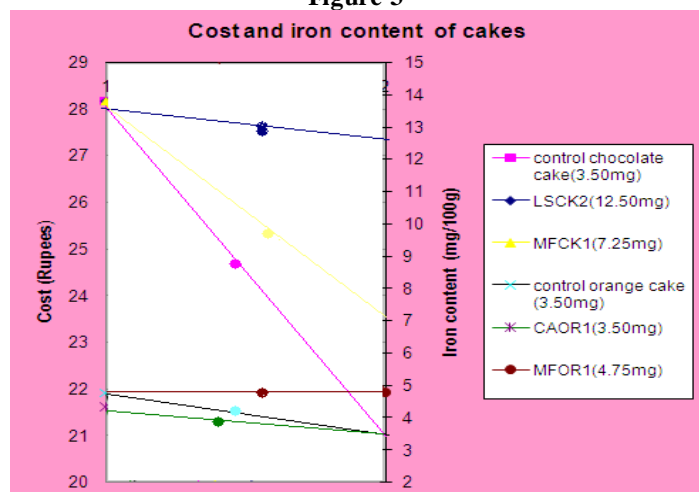
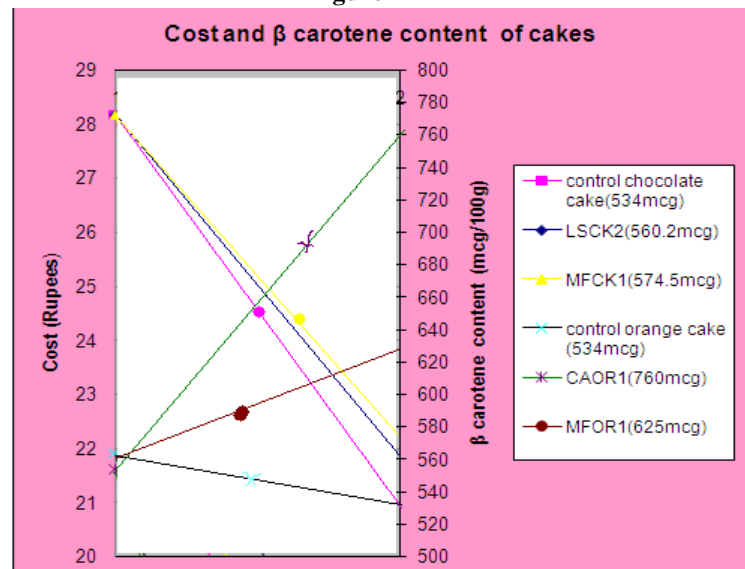


Figure 4



From the above, it is clearly understood that incorporation of lotus stem powder and carrot powder will only help to improve the micronutrient content and definitely not be a barrier in terms of cost.

Conclusion

Value addition of cakes using locally available under exploited foods is a possible venture and can be adopted by food processing industries to enrich the micronutrient content for correcting and eliminating micronutrient malnutrition in people among whom fast foods are popular.

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