

REGULAR ARTICLE

Dates as a substitute for added sugar in traditional foods – A case study with idli

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Abstract

Scientific evidences suggest that increased intake of added sugar is one of the major causes for dental caries, glucose intolerance, diabetes mellitus, cardiovascular diseases, obesity, hypertension and behavioural complications such as hyperactivity in children. In many parts of the world, consumption of added sugar is much higher than the dietary recommendation from health organizations. Several researchers have used dried fruits to sweeten the traditional foods as the functionality of the sugar incorporated within the structure of intact fruits is different than added sugar in human health. Date fruits have also been used in several forms such as syrups, spread, sugar and flour as a sweetener in food. The objective of this study was to develop acceptable idli (traditional Indian breakfast) with chopped dates, date paste and date syrup, and determine their sensory and chemical properties. Total phenol and vitamin C contents of dates idli were significantly higher than control idli with added sugar. The sensory properties of four idli products (idli with date paste, idli with date syrup, idli with chopped dates and control idli served with white sugar) were evaluated by 40 untrained panelists. The sweetness and aroma of the idli with chopped dates got significantly higher scores than other three idli products with no difference among them. Similarly the overall acceptability score of the idli with chopped dates was higher than other idli products. Panelists from a regular eaters group gave higher scores for the overall acceptability of developed idli products than first time consumers. In all sensory attributes and consumer types, idli with dates scored higher preference or at least equal preference with control idli and white sugar combination. There are ample opportunities to educate people and create awareness about preparation and consumption of traditional foods with dates in order to reduce added sugar intake.

Key words: Dates, Nitrification, Total phenols, Sensory, Added sugar

Introduction

Increased intake of added sugar might increase the risks for obesity, cardiovascular diseases, dental caries, glucose intolerance, diabetes mellitus, hypertension and behavioral complications such as hyperactivity in children (Anderson, 1997; Johnson and Yon, 2010). World Health Organization recommends limiting added sugar intake to <10% of total energy (Kranz et al., 2005; World Health Organization, 2003). The American Heart Association recommends limiting the daily added sugar intake to 100 calories for women and 150 calories for men (Johnson and Yon, 2010). The

food guide from the United States Department of Agriculture (USDA) recommends consumption of added sugar in the range between 6% and 10% of total energy (Welsh et al., 1993). Although added sugar intake is higher in many Asian countries, the statistical information for per capita intake is not available in the public domain.

Utilization of fruits in food preparation while requiring sweet taste is a wise strategy to reduce the added sugar intake. Dates are ideal fruits to substitute added sugar in foods, and they play an important role in daily nutrition of many people in the arid regions (Jain, 2012). Date fruits have been used in several forms such as juice, syrups, and spreads (El Hadrami and Al-Khayri, 2012). Dates are excellent raw materials for the production of value-added products such as medical and industrial ethanol, bakery yeast, single-cell protein as a fodder yeast, citric acid, and date flavored probiotic fermented dairy products (Aleid, 2011). Dates are rich in dietary fiber, phenolic compounds,

Received 17 October 2012; Revised 08 January 2013;
Accepted 10 January 2013; Published Online 24 July 2013

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minerals, vitamins and antioxidant compounds (Al-Farsi et al., 2007; Biglari et al., 2008; Taha et al. 2012). Al-Shahib and Marshall (2002) reported that the dietary fiber content of dates ranged from 8.1 to 12.7% (w/w). It has been determined that date fruits have potent antioxidant and antimutagenic qualities (Vayalil, 2002). The presence of insoluble fibers such as cellulose, hemicellulose, pectin, and lignins in dates, reduces the chances of bowel cancer and increases cardiac vitality (Baliga et al., 2011).

Idli is an indigenous food of India and Sri Lanka, and consumed three to four times a week at breakfast and supper. It is preferred by many people around the world because of its spongy texture, appearance, mouth feel, taste and aroma (Iyer and Ananthanarayan, 2008). The ingredients of idli are milled rice (*Oryza sativa*) and dehulled black gram (*Phaseolus mungo*) (Ghosh and Chattopadhyay, 2011). Rice and black gram are soaked separately and ground in a mortar and pestle with adequate water to yield a coarse rice batter and fine black gram batter (Blandino et al., 2003). Both the batters are mixed together with an adequate amount of salt and allowed to ferment overnight naturally. The fermenting microorganisms present in the batter use the reducing sugars for their growth and help in the fermentation process. Lactic acid bacteria play an important role in fermentation by producing acid and gas in the idli batter (Iyer and Ananthanarayan, 2008). The fermented batter is then poured in special idli pans and steamed for a few minutes. The cooked idli has a soft spongy texture and a characteristic taste and aroma (Nisha et al., 2005).

Generally idli is consumed with accompaniments such as chutney and sambar (Sharavathy et al., 2001). In many regions, people, especially children, prefer to eat idli with refined sugar (added sugar) for sweetness. The consumption of added sugar by children in Asian countries is high. High intake of fatty fast food coupled with reduced physical activity has promoted childhood obesity in many Asian countries. For example, although the prevalence of overweight and obesity among Indian adults is relatively lower (1.3 to 2.8%) compared to many other developed countries, it is higher among Indian children (18 to 21%) (IASO, 2007). The objective of this study was to develop acceptable idli products with chopped dates, date paste and date syrup, and determine their sensory properties.

Materials and Methods

Batter preparation and fermentation

Four parts rice and one part black gram dal (w/w) were washed and soaked separately in

potable water for 5 hours (Sridevi et al., 2010). After draining the water, rice and black gram were ground separately with water in a heavy duty mixer grinder (Preethi Blue Leaf mixer grinder, model – MG140E, 230 V, 750 W, 50 Hz, Preethi Kitchen Appliances (P) Ltd, Chennai, India). The black gram was ground to a fine, smooth paste, while the rice was ground coarsely. Both the batters were then incorporated together in a stainless steel container, 2% (weight/total weight of raw material) salt was added (Balasubramanian and Viswanathan, 2007) and mixed properly. Then the batter was allowed to ferment naturally for 18 hours at overnight room temperature ranging from 26 to 30°C (Murthy and Rao, 1997). Idli batters were prepared four different times (n=4).

Dates preparation for nutrified idli

Date paste

Fresh dried date fruits (cv. Khalas) were procured from the local market. The dates were soaked in warm water for 10 min to soften the flesh. The seeds were then removed manually and the flesh was ground in the mixer grinder (Preethi Blue Leaf mixer grinder, model – MG140E, 230 V, 750 W, 50 Hz, Preethi Kitchen Appliances (P) Ltd, Chennai, India) until a smooth homogenous paste was obtained (Sanchez-Zapata et al., 2011).

Chopped dates

A sharp stainless steel knife was used to remove the seeds and chop the dates (cv. Khalas) into small pieces, approximately 3 mm cubes.

Date syrup

Date syrup with 76 to 78% concentrate (Golden dates, United Dates Processing Company LLC, Azaiba, Sultanate of Oman) was purchased and used in this study.

Idli preparation

Normally, one idli is consumed with approximately one teaspoon of refined sugar (about 6 g). Hence, the date paste, date syrup and chopped dates were accordingly measured and mixed into separate fermented idli batters (presuming 60% sugar content in dates). The date products were blended with the fermented batter and used for idli preparation. The batter was poured separately into circular molded idli plates and steam cooked for 7 min in an electric idli steamer (Panasonic Automatic Cooker Warmer, model – SR/WA18H (T), 230V, 660W, 50Hz, Panasonic Home Appliances India Co. Ltd, Chennai, India). The steamed idli was carefully removed using a spatula and served to the panelists for sensory evaluation. In all the experiments, a control (fermented batter

without addition of dates) was also cooked and served with 6 g of sugar per idli.

Sensory evaluation

The sensory test was performed by 40 untrained panelists (N=40) selected randomly from the students and the staff members of Sultan Qaboos University and Hospital, Sultanate of Oman. There were 2 groups of panelists: first time eaters of idli (10 males and 10 females) and regular eaters of idli (10 males and 10 females). The sensory test was conducted in four batches (with idli products prepared from four different batters), and equal number of panelists participated from each group in each batch. A sensory evaluation sheet was designed and developed. The sensory attributes of idli were collected under four groups such as appearance (colour, surface smoothness), mouth feel and texture (softness, graininess, springiness), flavour and taste (sweetness, aroma) and overall acceptability. Four idli samples (idli with date paste, idli with date syrup, idli with chopped dates and idli served with sugar (control)) were evaluated by the panelists using a 9-point hedonic scale (9 – like extremely, 8 – like very much, 7 – like moderately, 6 – like slightly, 5 – neither like nor dislike, 4 – dislike slightly, 3 – dislike moderately, 2 – dislike very much and 1 – dislike extremely).

Statistical analysis

The effect of idli type and consumer type on individual sensory attribute was analyzed statistically using the Statistical Analysis System software (SAS, version 8.02, SAS Institute, Inc., Cary, NC). For each sensory attribute, the effect was studied by analysis of variance (ANOVA)

using 2–factorial design models [4 product types (idli with sugar (control) × idli with date paste × idli with date syrup × idli with chopped dates) × 4 consumer types (male–regular eaters × female–regular eaters × male–first time eaters × female–first time eaters)] with the general linear model (GLM) procedure. In all analyses, the differences within the levels under each variable were tested at 95% confidence interval (type I error, $\alpha = 0.05$) using the least significant difference (LSD) method of comparison of means.

Results and Discussion

Idli products

A preliminary study was conducted to determine the behavior of idli batter while adding date fruits in different forms (date paste, date syrup and chopped dates) before and after fermentation. When the date products were added into the batter before fermentation, the cooked idli products produced an undesirable taste (without sweetness) and showed significant differences in the texture compared to the control. The products were not satisfactory during preliminary screening by the authors. When the dates were added with batter after fermentation, the products obtained were soft, spongy, sweet and comparable with control idli. Addition of dates into the batter probably affects the fermentation process and produce undesirable flavor in cooked idli. Further investigation is required to study the effect of dates in the fermentation process. Three idli products (idli with date paste, idli with date syrup, idli with chopped dates) were developed by adding dates in the batter after fermentation (Figure 1) and their sensory properties were evaluated.



Figure 1. Developed idli products.

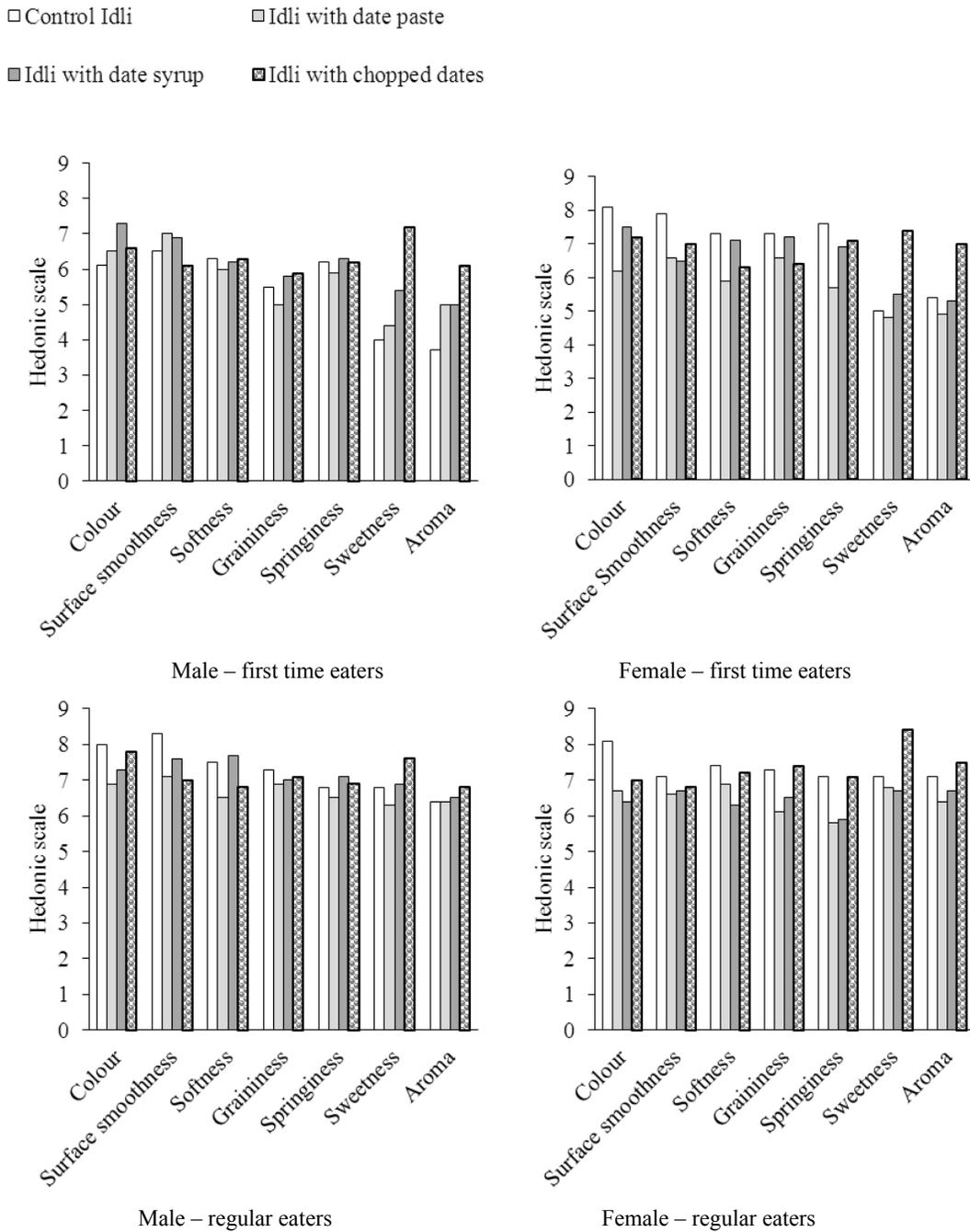


Figure 2. Sensory scores for developed idli products (n=40 panelists). Hedonic scale: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2- dislike very much and 1-dislike extremely.

Sensory evaluation

In order to attain eating quality, it is essential to include all important sensory features such as appearance, texture and flavour (Auerswald et al., 1999; Ben Ismail et al., 2013). A descriptive study on

the consumer acceptance of a new product or modified product is essential. The hedonic scores of various attributes of the developed idli products are given in Figure 2.

Appearance

Idli with date paste and date syrup had a homogeneous light brown colour whereas idli with chopped dates had dark specks wherever date pieces were present. The color of the control idli got the highest score and the idli with date paste got the lowest score. There were no differences in the surface smoothness scores of control idli, date paste idli and date syrup idli. However idli with chopped dates scored significantly lower in surface smoothness than control idli.

This suggests that, addition of dates in idli does not improve the appearance of the products. Date syrup has been widely used as sweetener in food. Aboubacar et al. (2010) determined uses of date syrup as a substitute sweetener for sucrose in food using muffin as a model product. Control muffin had lighter color compared to muffin with syrups. Muffins made with date syrup had significantly lower hedonic rate for appearance and color compared to the control muffin. It was concluded that color appears to be the major sensory attribute affecting consumer acceptability while adding more than 50% of date syrup.

Mouth feel and Texture

There were no differences between control idli, idli with chopped dates and idli with date syrup in the hedonic scores of softness and graininess. In all these attributes, idli with date paste scored lower than control idli. All panelists gave equal scores for the springiness of the developed idli products. The male- first time eaters gave the lowest scores for softness and graininess of the developed products, but there were no differences among the other three groups of panelists. The mouth feel and texture of modified products are dependent upon many factors including the amount of replacement, changes in the ingredients, and consumer's perception. For example, Rekha and Vijayalakshmi (2011) reported that fortified idli with soy residue okara was soft and spongy compared to control idli. While replacing white sugar with date syrup, Aboubacar et al. (2010) determined that up to 50% replacement of white sugar with date syrup produced similar texture and acceptance rating to that of control muffins.

Flavor and taste

The sweetness and aroma of the idli with chopped dates got the highest score (between 6 and 9) and there was no difference among the other three products. Similarly regular eaters of idli gave higher scores to these attributes than first time eaters for the developed idli products. The chopped dates probably maintained their freshness after

steaming and were preferred by the panelists. The flavor and taste might have improved during steaming of idli. Whenever the date chunks were bitten, the panelists might have felt the fruit taste and liked the product. In terms of sweetness and taste, researchers have compared the products while replacing white sugar with date syrup at various levels. Gouhari et al. (2005) investigated the possibilities of using date syrup to replace sucrose in ice cream. They prepared five types of ice creams (0% (control), 25%, 50%, 75%, and 100% replacement of sucrose with date syrup) and determined that the sensory properties of the modified ice cream were not affected up to 50% replacement. Gad et al. (2010) used date syrup as part of water (2%, 4%, 6%, 8%, and 10% v/v) in reconstituting skim milk powder during the processing of yogurt with 14% total solids. Yogurt enriched with 10% date syrup had the highest rating for sweetness and taste. However the sensory attributes of any product developed with chopped dates are not available in the public domain.

Overall acceptance

The hedonic scores for the overall acceptability of the developed idli products by the panelists are given in Figure 3. All idli products scored between 5 and 9 for the overall acceptability. Idli with chopped dates scored the highest acceptability than other products without any difference among them. Similarly, regular eaters gave a higher score for overall acceptability than first time eaters. In sensory evaluation, although, the individual sensory attribute score varies among the products, overall acceptability is a good indicator about their choice and likeliness of a specific product. For example, Sidhu et al. (2003) used date syrup from two varieties in Kuwait (Birhi and Safari) to replace sucrose in pan bread formulations [0% (control), 50%, and 100% replacement]. It was determined that in spite of lower score in crumb color of date syrup pan bread, there were no significant differences in texture and overall acceptability of control and date syrup pan breads. Similarly in our present study, although the appearance of the idli with chopped dates scored lower, the overall acceptability was higher than other products.

Table 1. Total phenol and vitamin C content of developed idli products (n=3).

Product	Total phenol (mg/ 100 g)	Vitamin C (mg/ 100g)
Idli with added sugar (Control)	4.5	0.19
Idli with date syrup	82.1	0.63
Idli with chopped dates	75.1	0.58

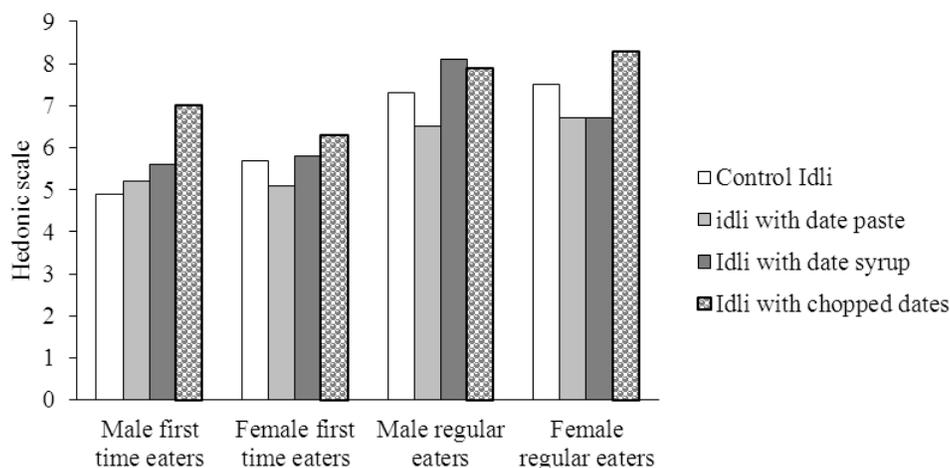


Figure 3. Overall acceptability scores of developed idli products (n=40 panellists). Hedonic scale: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2- dislike very much and 1-dislike extremely.

Total phenol and vitamin C

The total phenol, vitamin C and total reducing sugar contents of control idli and dates idli (idli with date syrup and idli with chopped dates) were measured (n=3). The total reducing sugar content of control idli, and dates idli was in the range of 140 to 180 mg/g without significant difference among them. Total phenols and vitamin C content of developed idli products are shown in Table 1. Dates idli contained higher total phenol and vitamin C content than the control idli. Al-Farsi and Lee (2012) reported that the phenolics and vitamin C contents of dried dates of several varieties were 353 mg/100 g and 1.88 mg/100g, respectively.

Conclusions

In many Asian countries the consumption of added sugar is relatively higher through coffee, tea, milk, juices, sweets and many other ethnic foods. It has been scientifically proven that increased intake of added sugar increases the risk factor for various diseases. To reduce the consumption of added

sugar, and enjoy the sweet taste, dates in various forms have potential to blend in ethnic food preparation. Nutrified idli with chopped dates were mostly preferred by all panelists in all groups with higher sweetness and aroma. Idli with chopped dates could be prepared easily by adding the required amount of chopped dates in the fermented batter just before cooking. In addition to health benefits, idli preparation with dates will improve the convenience of handling of idli in public places such as railway stations and food outlets without any separate accompaniments. Date fruits have great potential to use along with several traditional foods and reduce the consumption of added sugar.

Acknowledgement

This study was supported by SQU – Internal Grant No. IG/AGR/ SWAE/11/02 (Nutrification of traditional foods with Omani dates). The authors wish to thank Ms. Asma Mohammed Abdullatif Al-Maimani, Ms. Asma Talib Al-Hadhrami, Ms. Fatma Khalfan Al-Mahrouqi and Ms. Tharaya

Mansoor Mohammed Al-Amri for assistance in this project.

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