

Effect of Dates on Fermentation of *Appam* Batter

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Appam is a traditional fermented Indian food prepared with rice flour, white sugar and coconut milk. In this study, the effect of replacement of white sugar with dates (paste and syrup) on fermentation quality of batter and sensory properties of the cooked product were studied. An overall increase in bulk density, microbial load and a decrease in pH were observed after 5 h fermentation. *Appam* batter with date syrup showed the lowest bulk density (0.80 g/cm³) and pH (5.8). The mesophilic aerobes count in batters containing date products increased during fermentation time and it was in the range of 3.62 to 6.90 log₁₀ cfu/g during 5 h fermentation. Similarly the yeast and mold count for the date *appam* was in the range of 2.98 to 5.76 log₁₀ cfu/g. The *Lactobacillus* count in date-syrup and date-paste batters was higher than control batter in all stages of fermentation. It was in the range of 2.30 to 5.36 log₁₀ cfu/g for control and 3.65 to 6.24 log₁₀ cfu/g for dates added batter during 5 h fermentation. While analysing the sensory of cooked *appam*, there were no differences in most of the attributes between control and dates added *appam*. Therefore, dates have the potential to replace white sugar in *appam* and several other traditional foods.

Key words: Dates, fermentation, bulk density, pH, Mesophilic aerobes, yeast and molds, *Lactobacillus*.

Fermentation is one of the oldest and most economical methods of producing and preserving food (Billings, 1998). In addition, fermentation provides a natural way to destroy undesirable components, to enhance the nutritive value and appearance of the food, to reduce the energy required for cooking and to make a safer product (Simango, 1997). Fermented foods are produced world-wide using various raw materials, processing methods and microorganisms. The fermented foods are part of the day to day diet in all parts of the world. *Appam* is one such popular fermented breakfast food widely consumed in south India

and Srilanka. It is a bowl-shaped thin pancake with a crisp edges and a fluffy centre. It is prepared with fermented batter made of rice flour, coconut milk and sugar. After the batter has fermented for 3-5 hours, it is cooked in a pan then served with some accompaniments such as spicy condiment and curry (Petrina, 2011).

In most of the fermented products, the fermentation is natural and involves mixed cultures of yeasts, bacteria and fungi which bring about saccharification of starch in the starting material (Steinkraus, 1998). There are many starters traditionally used to improve the rate of fermentation like yeast, yoghurt and so on. Traditionally sugar is added to *appam* batter, which favours as substrate for microorganisms (Petrina, 2011). Addition of sugar during fermentation, helps as the substrate for yeast, make the product soft and tender by absorbing some of the water via caramelization that helps in browning of the crust (The Sugar Association, 2013).

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Date fruits play an important role in daily nutrition of many people in arid regions (Jain, 2012). Dates are rich in dietary fibre, phenolic compounds, vitamins and are known to possess potent antioxidant and antimutagenic properties (Al-Farsi and Lee, 2012; Vayalil, 2002; Benmeddour, *et al.*, 2013; Abessa *et al.*, 2013; Manickavasagan, 2012). Date fruits have been used in several forms such as juice, syrups and paste along with other foods (El-Hadrami and Al-khayri, 2012). Aboubacar *et al.* (2010) used date syrup as a substitute sweetener for sucrose in food using muffin as a model product.

The products containing up to 50% date syrup and control had similar sweetness, flavor, texture, and acceptance rating. Similarly, Gouhari *et al.* (2005) investigated the possibilities of using date syrup to replace sucrose in ice cream. The sensory properties of the modified ice cream were not affected up to 50% replacement. Sidhu *et al.* (2003) used date syrup to replace sucrose in pan bread formulations. The use of concentrated date syrup in pan bread formulations did not adversely affect the baking loss. Manickavasagan *et al.* (2013) added date paste, syrup and chopped dates in idli (traditional fermented Indian food made of rice and pulse) preparation by substituting dates with sugar as an accompaniment. Trigueros *et al.* (2012) used dates blanching water for reconstituting skim milk powder to produce low fat yogurt. Besbes *et al.* (2009) produced jam from hard dates thereby adding value to hard dates.

However, there is no published work about the usage of dates in fermented food and their role in fermentation. Therefore the objective of this study was to determine the effect of replacement of white sugar with dates on the fermentation of *appam* batter and sensory attributes of cooked *appam*.

MATERIALS AND METHODS

Raw materials

The rice flour, coconut milk powder, date fruits (Fard variety), date syrup (Golden dates, United dates processing company LLC, Azaiba, Sultanate of Oman) and sugar were purchased from a supermarket in Muscat, Sultanate of Oman.

To make paste, the date fruits were soaked in warm water for 10 min to soften the flesh. The

seeds were then removed and the flesh was ground in a mixer grinder (M/s Preethi Kitchen Appliances, Model MG140E, 230V, 750W, 50 Hz, Chennai, India) until a smooth homogenous paste was obtained (Sanchez-Zapata *et al.*, 2011).

Batter preparation

For control, 100 g rice flour, 50 g coconut milk powder, 15 g white sugar, 2 g salt and water were added in a stainless steel container, and mixed thoroughly to make a homogeneous batter. Similarly date-syrup and date-paste batters were prepared using the same raw materials and procedures as control except the white sugar. The amount of date-syrup and date-paste was calculated by assuming the sugar content in dates as 60%. All the batters were allowed to ferment for 5 h at room temperature ($29\pm 1^\circ\text{C}$). The entire experiment was repeated 3 times, and batter and product quality were analysed ($n=3$).

Batter analysis

The batter properties were measured up to 5 h at 1 h interval. The pH of different batters was measured using a digital pH meter (M/s Hanna instruments, Michigan, USA). For bulk density, about 30 ml of aliquots of batter were placed in 100 ml measuring cylinder and rise in volume during fermentation was measured (g/cm^3) at specific intervals of time (Steinkraus *et al.*, 1967).

The fermented *appam* batters were used for plating to determine mesophilic aerobes, yeast and molds and lactic acid bacteria. The microbial load at specific intervals of time was measured by suspending the respective batter in 0.5% sterile saline and plating it out at appropriate dilutions. MRS (De Man, Rogosa and Sharpe) media for lactic acid bacteria, PDA (potato dextrose agar) media for yeast and PCA (Plate count agar) media for Mesophilic aerobes were used. The techniques employed were spread plate and pour plate methods. After incubation colonies were counted on PDA, PCA and MRS. MRS, PDA and PCA media were procured from Hi-media Laboratory, Mumbai, India.

Appam preparation

After 5 h fermentation, one table spoon of the fermented batter was poured to the hot *appam* pan (Iron pan with deep bottom). The pan was lifted from the stove and swirled within 3 s after pouring. A few drops of oil was poured consistently around the *appam* and the pan was

closed by a lid for 2 min. Then the *appam* was gently removed from the pan. This product was presented to the sensory panellists without any accompaniments.

Sensory analysis

Three *appam* samples (control *appam*, date-syrup *appam* and date-paste *appam*) were evaluated by the panellists 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).

Appam samples were coded and presented to 60 panel members for sensory scoring. There were 2 groups of panellists: first time consumers (30 panel members) and regular consumers (30 panel members), from the staff and students of the Sultan Qaboos University. The sensory test was conducted in three batches. The *appam* was evaluated for color, smoothness, softness, chewiness, graininess, taste, aroma and overall acceptability.

In overall acceptability, the panellists were asked to rank the tested products according to their preferences such as 1, 2 and 3.

RESULTS AND DISCUSSION

Bulk density

The bulk density of *appam* batter ranged from 0.80 to 0.93 g/cm³, at different fermentation times (Fig 1a). In general, the bulk density decreased with the fermentation time due to entrapment of air/gas pockets produced due to the action of microorganisms (Mukherjee *et al.*, 1965). Bulk density of syrup and paste batters after 5 h of fermentation were 0.80 and 0.86 g/cm³, respectively which was significantly lesser than control (0.89 g/cm³) (Fig 1a). In date-syrup batter the bulk density was initially higher than other two products and then drastically reduced after 3 h fermentation. Increase in bulk density of fermented *idli* batter was also been observed by other researchers (Balasubramanian and Vishwanathan, (2007); Sridevi *et al.*, (2010), Chandini *et al.*, (2005)).

pH

The pH values of *appam* batters gradually decreased over a period of 5 h fermentation time (Fig 1b). The batter with date syrup reached a pH of 5.8 within 4 h, thereby increasing the rate of

Table 1. Sensory scores for quality attributes of *appam* – Regular consumers

Product type	Color	Texture				Aroma	Taste
		Smoothness	Softness	Chewiness	Graininess		
Control	7.0±1.9 ^a	6.8±1.7 ^a	6.4±1.9 ^a	6.5±1.8 ^a	6.4±2.3 ^a	6.3±2.3 ^a	6.6±2.2 ^{ab}
Date-syrup	6.3±2.0 ^a	5.7±1.8 ^b	6.1±2.0 ^a	6.4±1.6 ^a	6.1±1.7 ^a	6.4±1.8 ^a	6.9±1.8 ^b
Date-paste	6.5±1.9 ^a	6.0±2.1 ^{ab}	5.9±2.0 ^a	5.5±1.7 ^b	5.4±2.3 ^a	5.6±2.1 ^a	5.9±1.9 ^a

Values are expressed as mean ± standard deviation of 30 panelists and are indicative of following grades: 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.

* In each column, the mean values followed by same letter are not significantly different at P ≤ 0.05

Table 2. Sensory scores for quality attributes of *appam* - First time consumers

Product type	Color	Texture				Aroma	Taste
		Smoothness	Softness	Chewiness	Graininess		
Control	6.7±2.0 ^a	5.8±2.4 ^a	6.0±1.9 ^a	5.5±2.2 ^a	5.9±1.7 ^a	5.3±2.0 ^a	4.9±2.2 ^a
Date-syrup	6.1±2.5 ^a	5.7±2.2 ^a	5.8±2.1 ^a	5.8±2.2 ^a	5.7±2.2 ^a	5.5±2.4 ^a	6.0±2.5 ^a
Date-paste	6.0±1.9 ^a	5.3±2.0 ^a	5.3±2.0 ^a	5.3±2.0 ^a	5.6±1.9 ^a	5.4±2.1 ^a	5.3±2.4 ^a

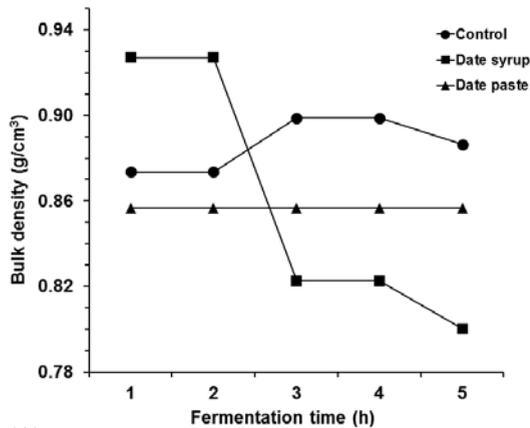
Values are expressed as mean ± standard deviation of 30 panelists and are indicative of following grades: 9 - like extremely, 8 - like very much, 7 - like moderately, 6 - like slightly, 5 - neither like nor dislike, 4 - dislike slightly, 3 - dislike moderately, 2 - dislike very much and 1 - dislike extremely.

* In each column, the mean values followed by same letter are not significantly different at P≤0.05

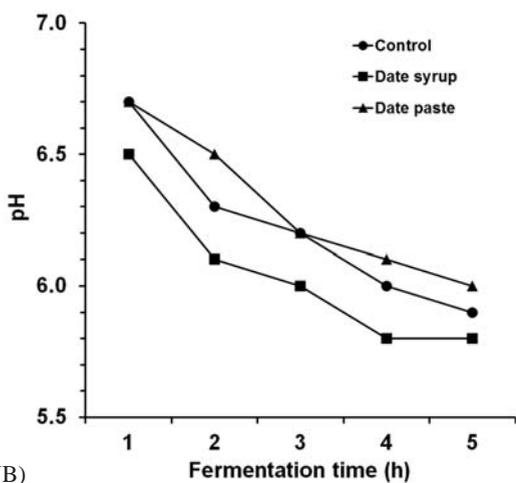
fermentation time. The batter with date paste reached pH of 6.0 and that of sugar reached a pH of 5.9 after 5 h fermentation from the initial batter pH 7.0. Since *appam* batter was kept for short duration of fermentation, not much pH drop could be expected as in Idli batter which is kept for 8-12 h fermentation. Bacteria along with some yeast are mainly responsible for production of acids and gas from simple sugars like glucose and maltose. This accounts for fall in pH and rise in volume and acid content of the batter as the fermentation progresses (Soni *et al.*,1986).

Microbial profile

The plates inoculated with fermented batter prepared with date syrup, paste and sugar showed a substantial increase in the load of

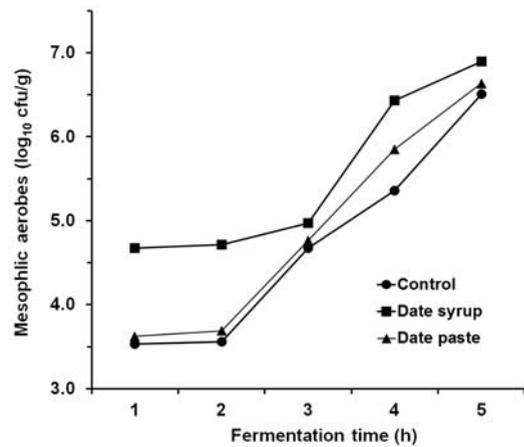


(A)

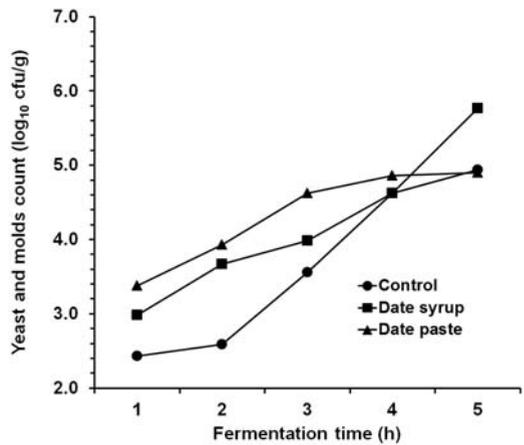


(B)

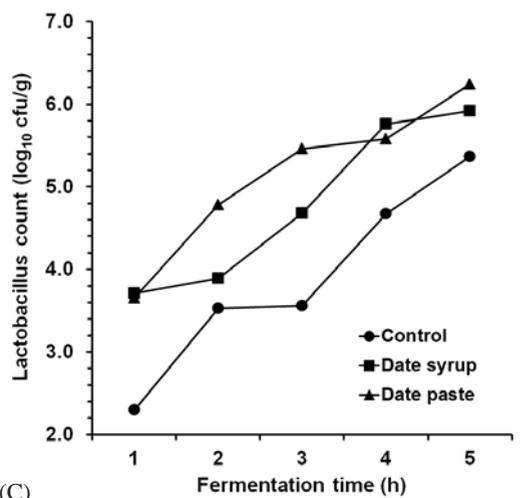
Fig. 1. Physico-chemical characteristics of fermented *appam* batter at various intervals of time (n=3)



(A)



(B)



(C)

Fig. 2. Microbial profile of fermented *appam* batter at various intervals of time (n=3)

microbes with increase in fermentation time upto 5 h (Fig 2). The mesophilic aerobes count for date syrup ranged from 4.67 to 6.90 \log_{10} cfu/g and for date paste 3.62 to 6.63 \log_{10} cfu/g with increase in fermentation time (Fig 2a). Fermented batter with date syrup produced highest microbial count of 6.90 \log_{10} cfu/g at 5h. Similarly, batter with date syrup gave higher yeasts and molds counts of 2.98 to 5.76 \log_{10} cfu/g compared to batters with date paste and sugar (Fig 2b). It has been reported that yeast mainly contributes towards the acid and gas production (Soni and Arora, 2000). Higher Lactic acid bacteria counts of 3.65 to 6.24 \log_{10} cfu/g was obtained for batter with date paste and date syrup (Fig. 2c) which was higher than control. Microorganisms play an important role in the fermentation process by secreting a number of enzymes, which catalyse the hydrolysis of carbohydrates, lipids, proteins, anti-nutritional and toxic factors (Rolle, 1998).

Sensory analysis

Mean sensory scores by regular and first time consumers obtained for various quality parameters of *appam* are shown in Tables 1 and 2. The *appam* prepared with date syrup and paste was not significantly different from control in most of the sensory parameters.

Color

Appams prepared with date syrup and paste given scores ranging from 6.0 to 6.5 for the quality of color representing quality grade of *like slightly* for all samples. However, there were no significant differences between three products. Aboubacar *et al.* (2010) reported that muffins prepared with date syrup had a limit for date syrup to less than 50% without affecting the acceptability.

Texture

The quality of texture followed a different trend wherein the differences between products made with dates were minimal with control, and the scores given were in quality grade of *like slightly to moderately*. The scores of regular and first time consumers of *appams* with date syrup and paste ranged from 5.3 to 6.8 for smoothness, 5.3 to 6.4 for softness, 5.3 to 6.5 for chewiness and 5.4 to 6.4 for graininess. There were no differences in various texture attributes of three products in first time consumer group. However, smoothness of date-syrup and chewiness of date-paste products were lower than control in regular consumer group. Chandini *et al.* (2005) obtained softer idlis with low polished rice owing to greater surface microflora in low polished rice. Similarly Bharathi and Ananthanarayan, (2008) obtained softer idli with the addition of 5 and 15 U of α -amylase enzyme in idli batter.

Aroma

For aroma, *appams* made with date syrup and *paste* were graded as *like slightly to moderately* (5.4-6.4). There was no significant difference in the scores for aroma. Dates give sweet aroma so panelists showed same preference to that of control.

Taste

There were no differences in the scores obtained for taste of control and *appam* with date-syrup and date-paste. However, there was a difference in the taste between *appam* with syrup and paste in regular consumer group. Gouhari *et al.* (2005) replaced sugar with date syrup in ice cream, and set a limit of 50 % for date syrup to get an acceptable product.

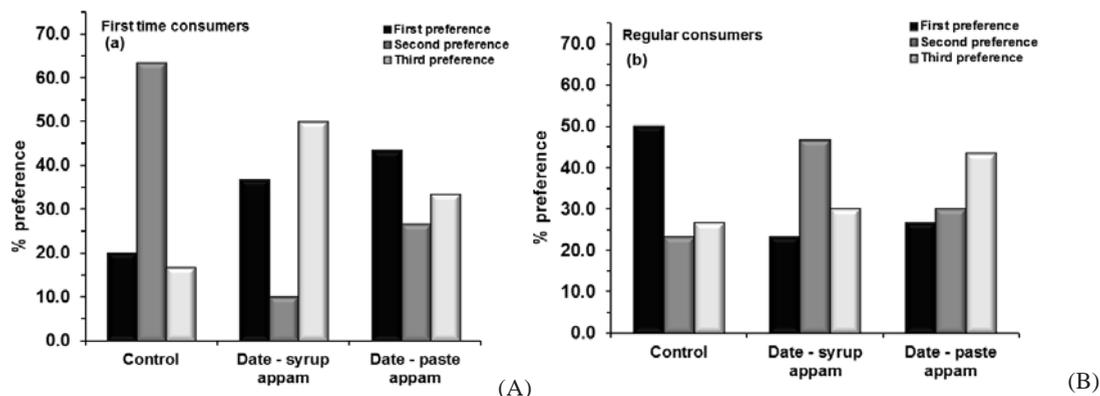


Fig. 3. Overall acceptability of *appam*

Overall acceptability

In first time consumer group, 80% of the panellists preferred date *appam* (either syrup or paste) as the first choice (Fig. 3a). But only 50% of the panellists selected date *appam* as their first choice in the regular consumer group (Fig. 3b). Probably the regular consumers became familiar with the taste of white sugar *appam* and therefore 50% of them might have gone for the control as first choice. Similarly in third choice category, 50% of first time consumers selected date-syrup *appam* and 43% of regular consumers selected date-paste *appam*. Sidhu *et al.* (2003) replaced sucrose with date syrup in pan bread formulations. In spite of the lower crumb color, the bread with date syrup was acceptable overall. In general, *appam* prepared with dates broadly preferred and accepted by different types of panellists.

CONCLUSIONS

The study revealed that the use of date syrup and paste in the *appam* batter could achieve improved performance than that of batter with sugar. The characterisation of fermented batter suggested that the dates could serve as a fermentation enhancer. The results revealed that the *appam* with date syrup and paste may be preferred over sugar as it not only maintained the sensory quality but also could improve the nutritional quality of the *appam*. Future studies should focus on the use of date fruits along with traditional foods and reduce the consumption of sugar.

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