

# Effect of processing of dates into date juice concentrate and appraisal of its quality characteristics

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**Abstract** Date palm (*Phoenix dactylifera*) is widely cultivated in Kutch district of Gujarat and the fruits are harvested at immature stage before the onset of monsoon to prevent spoilage. The immature date fruits with less commercial value were used for processing into date juice concentrate. Immature dates were crushed and treated with 0.1% pectinase enzyme for 120 min to obtain maximum juice. Date juice was found to be rich in reducing sugars (16.1%) and total sugars (18.3%). Juice was pasteurized at 85°C to inactivate the enzyme, cooled and centrifuged at 3000 rpm to get clear juice. The juice was concentrated in a thin film evaporator to a total soluble solids (TSS) of 76°Brix in 2 passes. Chemical composition of date juice during different stages of concentration was determined. Date juice concentrate was packed in low density polyethylene bags of size (22 cm × 14 cm) and frozen in blast freezer at –40°C and stored at –20°C. Storage of date juice concentrate at –20°C for 6 months indicated no significant changes in TSS, acidity, ascorbic acid, total sugars and pH. Hunter colour lightness L, and redness a values of date juice concentrate decreased whereas b values increased during storage. Date juice concentrate was stable during 6 months storage could be reconstituted for preparing ready-to-serve beverages with acceptable sensory quality.

**Keywords** Dates. Date juice. Juice concentrate. Enzyme clarification. Date beverage

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## Introduction

Dates are important fruits grown in Kutch district of Gujarat in India. Dates are rich in carbohydrates, tannins and minerals; they exhibit antioxidant, antimutagenic and free-radical-scavenging activity (Vayalil 2002). Dates from this region are generally harvested at immature stage due to the on set of monsoon. Freshly harvested immature date fruits have 4–6 days shelf life at ambient conditions. Al-Hooti et al. (1997a) prepared fortified date bars containing skim milk powder, almond, oat flakes or sesame seeds from commonly grown date cultivars in the UAE. Date fruits from 5 cultivars commonly grown in UAE collected at different stages of maturity were utilized for the preparation of pickles in oil and vinegar and *chutney* (Al-Hooti et al. 1997 b,c). Physico-chemical composition and utilization of immature dates grown in Kutch district of Gujarat for the preparation of dehydrated dates are reported by Kulkarni et al. (2008).

Fruit juices have tendency to loose flavour, vitamins and colour during processing when subjected for heating in open conditions. Even at moderate heating many of the juice nutrients are lost. Fruit juices could be concentrated by different methods. The fruit juice concentrate with maximum retention of colour, flavour and vitamins has great demand in the international market. Bolin and Salunkhe (1971) evaluated various concentration methods for apple, sour cherry and peach juices. Demeczky et al. (1981) reported the comparative assessment of semi concentrate from sour cherry, peach juices produced by reverse osmosis and vacuum thermal evaporation. Clarification of fruit juices by physical or chemical means yields low viscosity juices, which makes easier and gives higher degree of concentration. Concentration of Kinnow juice by reverse osmosis was reported by Khamrus and Pal (2002). However, information on concentrating of date juice from immature dates and changes in quality and colour during concentration is not available. The objective of the present work was to study the extraction of juice from immature dates, development of juice concentrate, storage stability and its utilization for the preparation of ready-to-serve-beverages.

## Materials and methods

Freshly harvested immature date (*Phoenix dactylifera*) clusters were procured from Kutch district of Gujarat. The date fruits weighing 20 kg were packed in ventilated corrugated fiberboard boxes and transported by air for the experimental studies. The date fruits were separated from clusters, sorted, washed and used for the preparation of juice concentrate. Commercially manufactured pectinase enzyme (bio pectinase) was procured from M/s Biocon India Ltd, Bangalore.

**Extraction of date juice:** Fresh and firm dates were washed and crushed in a fruit mill. The pulp was preheated to 45°C and divided into different parts for enzyme treatment. The pectinase enzyme was pipetted (0.05 and 0.1 ml / 100 g pulp) into the date pulp. The enzyme treated pulp was incubated at 45°C for 30–150 min. After clarification, treated date pulp was pressed in a hydraulic press for extracting the juice. The date juice yield was measured and recorded as weight/weight of pulp. The juice was heated to 85°C for 60 sec to inactivate the added enzyme and cooled.

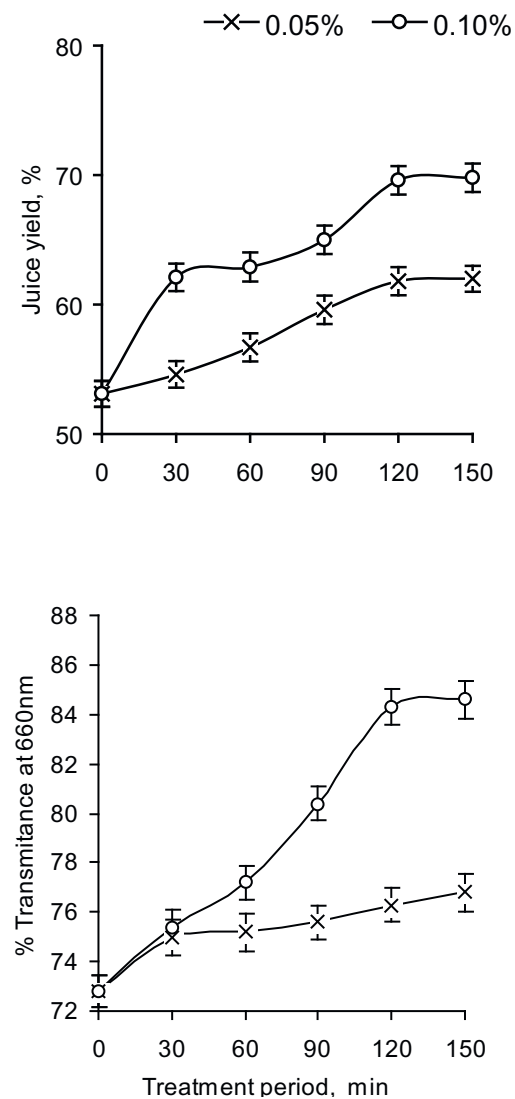
**Analysis:** Juice extracted from immature dates and date juice concentrate (DJC) were analyzed for total soluble solids (TSS) using a digital refractometer (Model RX 5000, ATAGO, Japan). The titratable acidity, reducing sugars, total sugars, ascorbic acid and tannins were determined by AOAC (2000) methods. Pectin content in juice was determined according to the method described by Ranganna (1986). The non-enzymatic browning (NEB) was determined by measuring the absorbance of the alcoholic extract at 440 nm. Twenty g of date juice was mixed with 100 ml of 60 % alcohol, held overnight at 27±1°C and the extract was filtered through Whatman Nr 41 filter paper. The optical density (OD) of the filtrate was measured at 440 nm in UV–visible spectrophotometer (Model Cintra–GBC-10, Australia) as also transmittance of enzyme treated and clarified juice at 660 nm. The enzyme treated date juice was centrifuged at 3000 rpm at room temperature (27±1°C) to remove the suspended materials in the clarified juice using nozzle type of centrifuge. The clarified date juice was concentrated in a vacuum evaporator. The clarified date juice was passed through evaporator (thin film evaporator, Turba film model 04012) at 50°C and vacuum of 24 inches of Hg. Juice was concentrated in two passes. The concentrate was collected during different stages of concentration for analysis. Hunter colour values of fresh date juice and DJC were measured using Shimadzu colour measuring system (Model Nr UV–2100) at wave lengths ranging from 360 to 800 nm and expressed as L, a, b, where L = lightness, a (+) = redness, b (+) = yellowness (Hunter 1975).

**Storage studies of date juice concentrate:** The DJC (500 g) was filled in low density polyethylene pouches of 50 micron thickness, sealed and frozen in blast freezer at –40°C (Foster BOP-50, England) and stored at –20°C in a deep freezer. The pouches were periodically removed for analysis up to 6 months.

**Preparation of beverages:** The stored DJC was used to prepare ready-to-serve beverage by adding water and citric acid. The beverage was adjusted to 14°Brix and 0.28% acidity. The blended juice was heated to 90°C for 2 min and filled in sterilized ready-to-serve beverage of 200 ml capacity bottles and sealed by crown corking. The sealed bottles were allowed to cool overnight at room temperature.

**Sensory evaluation:** Ready-to-serve beverage prepared from DJC was evaluated for sensory colour, taste, flavour and overall quality by a panel of 9 judges using Hedonic scale (where 1–2 = poor, 3–4 = fair, 5–6 = good, 7–8 = very good and 9–10 = excellent) (Amerine et al. 1965). Samples receiving an overall quality score of 7 or above were considered acceptable.

**Statistical analysis:** Analysis was carried in 3 replicates (Microsoft Excel 2000). The sensory data was analyzed by 2-way analysis of variance and the significance was determined (Steel and Torrie 1980).



**Fig. 1** Effect of pectinase enzyme (0.05 and 0.1%) treatment on yield and transmittance of date juice

**Results and discussion**

*Chemical composition of dates juice:* Freshly extracted date juice contained TSS 19.5%, reducing sugars 16.1%, total sugars 18.3%, ascorbic acid 13.2 mg /100 g, titratable acidity (as citric acid) 0.09%, tannin 0.38% and pectin 3.6% and its pH was 5.1.

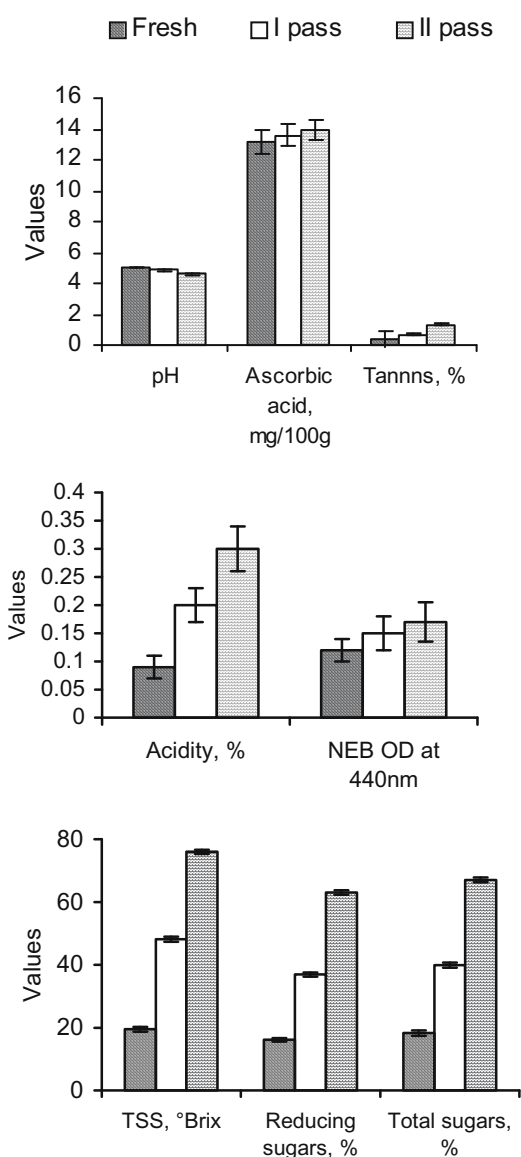
*Effect of enzyme treatment on yield and juice clarity:* Juice yield was 53.1% in control sample with high turbidity. Higher juice yield of 69.8% and clarity of juice (84.3% transmission at 660 nm) was observed with 0.1 ml pectinase enzyme per 100 g date juice as compared to control (Fig. 1). Juice yield and clarity increased with time initially up to 120 min and thereafter remained constant. Further, yield and clarity of juice increased with increase in enzyme concentration (Fig. 1). Floribeth et al. (1981) re-

ported that of pectinolytic enzyme treatment increased yield and clarity of juice from ripe banana pulp.

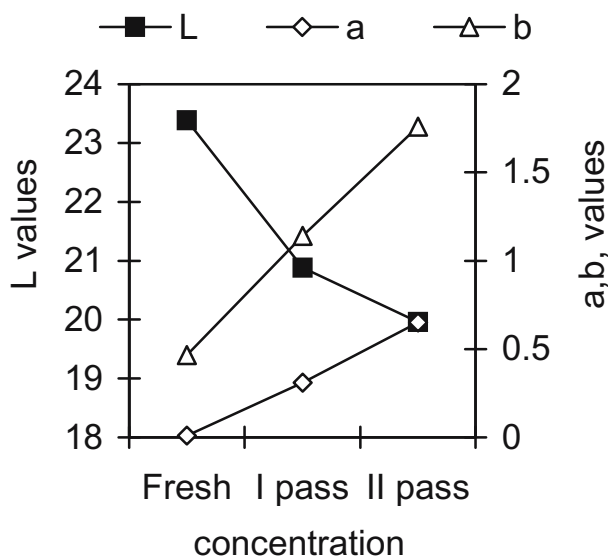
*Effect of vacuum concentration of date juice:* The TSS increased from 19.5 to 76.0% and acidity from 0.09% to 0.3% during concentration of date juice in 2 passes (Fig. 2). Significant increase in reducing sugars (63%) and total sugars (67%) was observed during the concentration of date juice. Ascorbic acid content also showed similar trend and increased to 13.9 mg/100 g. Tannin content and NEB of DJC increased slightly during concentration. The colour of the DJC after 2 passes was light brown and Hunter colour values of the concentrate were L (20.0), a (0.65) and b (1.76) (Fig. 3). Hunter colour values during vacuum evaporation process of pomegranate juice were reported by Medeni Maskan (2006).

*Effect of frozen storage:* Results in Table 1 indicate that no significant changes were observed in TSS, acidity, ascorbic acid, total sugars and pH. There was an increase in NEB, reducing sugars and tannin and decrease in non-reducing sugars during 6 months storage. The increase in reducing sugars may be due to inversion of non reducing sugars. Similar observations were reported on the effect of storage conditions on pineapple juice concentrate (Sandhu et al. 1985) and debittered kinnow mandarin juice concentrate (Thakur et al. 2000). Hunter value lightness (L), and redness (a) values of date juice concentrate were decreased and yellowness (b) increased significantly during storage.

*Quality characteristics of ready-to-serve beverages prepared from date juice concentrate:* The OD at 440 nm of beverages increased from 0.04 to 0.13 and tannin content decreased from 0.12 to 0.05% during 6 months storage and other parameters remained almost unchanged (Table 2). The RTS beverages prepared from DJC stored at



**Fig. 2** Chemical changes in date juice during concentration (n=3)



**Fig. 3** Changes in Hunter colour values (L, a, b) of date juice during concentration

**Table 1** Changes in chemical quality characteristics of date juice concentrate during frozen ( $-20^{\circ}\text{C}$ ) storage

	Storage period, months			
	0 (Initial)	2	4	6
pH	$4.6 \pm 0.05^a$	$4.5 \pm 0.05^a$	$4.6 \pm 0.05^a$	$4.5 \pm 0.05^a$
Acidity, % citric acid	$0.33 \pm 0.01^a$	$0.35 \pm 0.01^a$	$0.34 \pm 0.01^a$	$0.34 \pm 0.01^a$
TSS %	$76.0 \pm 0.32^a$	$76.2 \pm 0.32^a$	$75.8 \pm 0.32^a$	$76.6 \pm 0.32^a$
Reducing sugars, %	$63.0 \pm 0.20^a$	$63.3 \pm 0.20^a$	$63.6 \pm 0.20^{ab}$	$64.0 \pm 0.20^b$
Total sugars, %	$67.0 \pm 0.30^a$	$67.0 \pm 0.30^a$	$66.7 \pm 0.30^a$	$66.5 \pm 0.30^a$
Non-reducing sugars %	$3.8 \pm 0.02^a$	$3.5 \pm 0.02^a$	$3.0 \pm 0.02^b$	$2.4 \pm 0.02^c$
Ascorbic acid, mg/100g	$13.0 \pm 0.14^a$	$12.95 \pm 0.14^a$	$12.7 \pm 0.14^a$	$12.6 \pm 0.14^a$
Tannins %	$1.16 \pm 0.03^a$	$1.24 \pm 0.03^a$	$1.26 \pm 0.03^{ab}$	$1.36 \pm 0.03^b$
NEB OD at 440 nm	$0.17 \pm 0.02^a$	$0.35 \pm 0.02^b$	$0.38 \pm 0.02^{bc}$	$0.42 \pm 0.02^c$
Hunter colour L	$19.9 \pm 0.05^a$	$17.7 \pm 0.05^b$	$15.8 \pm 0.05^c$	$12.4 \pm 0.05^d$
a	$0.65 \pm 0.02^a$	$0.42 \pm 0.02^b$	$0.34 \pm 0.02^c$	$0.40 \pm 0.02^d$
b	$176 \pm 0.02^a$	$2.5 \pm 0.02^b$	$3.2 \pm 0.02^c$	$4.1 \pm 0.02^d$

TSS= Total soluble solids, NEB= Non enzymatic browning

Means followed by same superscripts within a row do not differ significantly ( $p \leq 0.05$ ) ( $n=3$ )

**Table 2** Chemical and sensory quality characteristic of ready-to-serve beverage prepared from stored date juice concentrate

	Storage ( $27-33^{\circ}\text{C}$ ) period, months			
	0 (Initial)	2	4	6
<b>Chemical (n = 3)</b>				
TSS, %	$14.0 \pm 0.04^a$	$14.1 \pm 0.03^a$	$14.0 \pm 0.04^a$	$14.2 \pm 0.04^a$
pH	$3.3 \pm 0.02^a$	$3.3 \pm 0.01^a$	$3.3 \pm 0.02^a$	$3.3 \pm 0.02^a$
Total acidity, %	$0.29 \pm 0.02^a$	$0.30 \pm 0.02^a$	$0.28 \pm 0.03^a$	$0.29 \pm 0.03^a$
Reducing sugars, %	$11.1 \pm 0.04^a$	$11.3 \pm 0.03^a$	$11.5 \pm 0.03^b$	$11.8 \pm 0.04^c$
Total sugars, %	$12.9 \pm 0.04^a$	$13.0 \pm 0.2^a$	$13.1 \pm 0.04^a$	$12.9 \pm 0.05^a$
Tannins, %	$0.12 \pm 0.03^a$	$0.10 \pm 0.05^b$	$0.07 \pm 0.02^c$	$0.05 \pm 0.03^d$
NEB, O.D at 440 nm	$0.04 \pm 0.02^a$	$0.06 \pm 0.05^b$	$0.09 \pm 0.03^c$	$0.13 \pm 0.04^d$
<b>Sensory quality (n= 9 panelists)</b>				
Colour	$8.8 \pm 0.03^a$	$8.0 \pm 0.0^b$	$7.7 \pm 0.02^c$	$7.2 \pm 0.03^d$
Taste	$8.0 \pm 0.02^a$	$7.8 \pm 0.02^a$	$7.5 \pm 0.03^b$	$7.0 \pm 0.0^c$
Flavour	$8.9 \pm 0.05^a$	$8.5 \pm 0.04^b$	$8.0 \pm 0.03^c$	$7.6 \pm 0.03^d$
Overall quality	$8.5 \pm 0.02^a$	$8.2 \pm 0.03^a$	$7.4 \pm 0.05^b$	$7.0 \pm 0.04^a$

TSS= Total soluble solids, NEB= Non enzymatic browning

Means followed by same superscripts within a row do not differ significantly ( $p \leq 0.5$ ) ( $n=3$ )

$-20^{\circ}\text{C}$  was sensorily acceptable even after 6 months storage at  $-20^{\circ}\text{C}$  as indicated by score of  $\geq 7.0$  for all attributes (Table 2).

## Conclusion

Immature dates could be used for the production of DJC. The DJC is also good source of sugars, tannins and ascorbic acid as it contained 76% TSS, 0.33% acidity, 63% reducing sugars, 67% total sugars, 1.16% tannins and its NEB at 440 nm was 0.17. The DJC packed in low density polyethylene pouches of 50 micron thickness, frozen in a blast freezer at  $-40^{\circ}\text{C}$  and stored at  $-20^{\circ}\text{C}$  was stable

for 6 months and could be used for the preparation of ready-to-serve beverages with sensorily acceptable quality characteristics.

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