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Changes in physico-chemical properties of wild date palm (*Phoenix sylvestris*) sap over its peak production period

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ABSTRACT

Phoenix sylvestris Roxb. sap plays an important role in the diet of inhabitants of tribal area of West Bengal. In the present study the sap of 15 to 20 years old trees was collected separately during December to February, 2012-13 and 2013-14 from Haringhata block in Nadia district of West Bengal (India). The results indicated that the specific gravity of the sap changed little from 1.041 to 1.052 during December to February while the total soluble solids (TSS) were found maximum during February (14.33%). Chemical composition analysis revealed that a sap with highest pH (6.75) and lowest acidity (0.04%) was found during January while the sugar/acid ratio decreased from 325.47 during January to 42.93 during February. The sap of wild date palm had the maximum ascorbic acid content (18.75 mg/100 ml) during December while it decreased to 14.58 mg/100 ml during January and 13.75 mg/100 ml during February. Alcohol content was highest during February, whereas it decreased gradually during January and December. The sap also contained ample amount of phenol ranging from 67.90 mg/100 ml to 81.47 mg/100 ml. Total sugar content was greater during February (12.50%) than during January (11.72%) and December (11.37%). The overall results revealed that the wild date palm sap is a good nutrient supplement and is opulent in TSS, vitamin C and carbohydrate. So the sap can be used as a good alternative source of health drink and to alleviate malnutrition of poor tribal population of West Bengal (India).

Key words: Ascorbic acid, Carbohydrate, *Phoenix sylvestris*, Phenol, Sap, TSS

The wild date palm or silver date palm (*Phoenix sylvestris* Roxb.) locally known as khajur, produces sap seasonally. It is one of the most common palms and its sap is known as Taadi. This is a well known source of sugar and consumed like a refreshing resources. The sap of date palm oozing out is a good source of vitamins of the B group and contains an appreciable amount of ascorbic acid. The sap is evaporated down to the crude sugar (molasses) which is largely eaten in West Bengal (Anonymous 2000). The sap is sensitive and transforms to an alcoholic beverage by spontaneous fermentation.

The palm is one of the important horticultural crops in many countries (Dalibard 2007). A significant economic return is possible from the cultivation of palm. Other than sugar production, this palm is also widely used for some other purposes as mat making, fencing, animal feed, shade and soil amendment (FAO 2007). Wild date palm is one of the oldest fruit trees in the world (Zohary and Hopf 2000). Generally the trees of wild date palm grow on farmland boundaries, homesteads and marginal land in rural areas. Also it is cultivated in orchards or raised by planting wild or nursery-raised seedlings. *Phoenix sylvestris* along with all other domesticated palms provides a wide array of commercial products for human kind and is often the main subsistence resource for the poorest people (Dalibard 2007). *Phoenix sylvestris* husbandry is one of the important means of seasonal livelihoods in rural West Bengal. The farmers are applying solely indigenous knowledge of their own in the farming and management of wild date palm in West Bengal. It plays an active role in the contribution to rural economy considering multipurpose uses. It can contribute in many ways to the sustainability of integrated farming systems. Sustainable management of the palm on the other hand can upgrade the microclimatic condition enriching the vegetation resources of the country.

The present paper is an attempt to characterize the physico-chemical properties of wild date palm sap and highlight its nutritional qualities. This will help to increase the income and livelihood of local and poor people through enhancing business opportunity by growing wild date palm.

MATERIALS AND METHODS

The wild date palm trees grown in the homestead of the farmers were selected for the collection of the sap sample. For this purpose the contact was made with the local farmers who grow and domesticate wild date palm

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plants for their food and livelihood. The sap of 10 plants (15 to 20 years old trees) was collected separately from different places of Haringhata block (locations of wild date palm) in Nadia district of West Bengal (India) during December, January and February.

A small incision of 15 cm below the foliage crown of the trunk was made in the bark of the silver date palm. Clean earthen pots were tied around the trees in the evening with their necks touching the incision portion of the trees to collect the sap by tapping method during whole of the night. Sap exudation of whole night was collected in the next morning between 4 to 6 am. After collecting the sap, it was homogenized, filtered and stored in the refrigerator and in room temperature separately for analysis. The estimation of different components was determined by volumetric and colorimetric methods and by standard conventional methods adopting the principles of analytical chemistry.

Proximate analysis was done separately after collecting the sap and data were statistically analysed. Data with ten replications were analysed by CRD (Complete Randomized Design) method. The parameters considered for analysis may be grouped in the following heads-

Physical parameters: specific gravity and total soluble solids.

Biochemical parameters: pH, acidity, sugar/acid ratio, ascorbic acid, alcohol, phenol and carbohydrate.

Specific gravity was recorded by hydrometer, TSS was measured with the help of refractometer and the pH of the extracts was measured by the pH meter.

Acidity was measured using a coloured indicator phenolphthalein. Three drops of phenolphthalein was added to the juice/water solution in each beaker by a dropping pipette. The titration was done slowly into the juice/water solution with a 25 ml burette using 0.1 M solution of NaOH. The phenolphthalein indicator changes very rapidly from colourless to pink therefore the NaOH was added a drop at a time towards the end of the titration. When the indicator had changed from colourless to pink the amount of NaOH used (titre) on the burette was read to measure the acidity percentage (AWWA *et al.* 1998, Sawyer *et al.* 2000).

Ascorbic acid was estimated by volumetric method given by Harris and Ray (1933). Five ml of sap sample and 5 ml of standard solution of ascorbic acid was taken in a beaker separately. Ten ml of oxalic acid (4%) was added to this mixture and titrated against 2, 6-dichloro phenol indophenols dye. The amount of the dye consumed was equivalent to the amount of ascorbic acid (Sadasivam and Theymoli 1987).

Alcohol estimation was done according to method used by Venkatachalapathy *et al.* (2014) with some modifications. Ten days fermented sap (250 ml) was distilled at the suitable temperature (78^0C - 80^0C at which alcohol evaporates) by distillation method and used distilled alcoholic sap sample for analysis. Five ml distilled alcoholic sap sample was diluted to 50 ml with distilled water. From that dilution 0.1 ml was taken separately in test tubes and diluted to 5 ml again with distilled water. Five ml potassium dichromate acidic solution was added to each tube and heated for 20 minutes. After cooling, absorbance was read at 600 nm and alcohol content was calculated from the standard graph and expressed as moles alcohol per 100 ml.

The total phenols were determined by Folin – Ciocalteau reagent method described by Malik and Singh (1980). For this purpose sap sample was mixed in 10-time volume of 80% ethanol and centrifuged at 10 000 rpm for 20 minutes. The supernatant was collected and saved separately. The extraction was repeated with 5 times volume of 80% ethanol, centrifuged again and the supernatants pooled to the earlier one. Supernatant was evaporated to dryness and the residue dissolved in 5 ml water. 0.2 ml aliquots were taken separately in test tubes and the volume was made up to 3 ml with water. 0.5 ml Folin Ciocalteau Reagent (FCR) was added and then after 10 minutes 2 ml of 20% Na_2CO_3 was added to each tube. The solution in the tubes was mixed thoroughly and placed in boiling water bath for exactly 1 minute. It was then cooled and absorbance read at 650 nm against reagent blank. Using standard curve of catechol, concentration of phenol was calculated and expressed as mg phenols per 100 ml sap.

Sap sample were extracted with hot 80% ethanol and evaporated on water bath at 80^0C. The sugar was dissolved in 10 ml water. 0.2 ml aliquots were taken in separate test tubes and their volume made up each to 2 ml with distilled water. 1 ml alkaline copper tartrate reagent was added and boiled for 10 minutes. After cooling, 1 ml of arsenomolybdate reagent was added and volume made up to 10 ml with water. By taking absorbance at 620 nm, the amount of reducing sugar was calculated with the help of standard graph (Somogyi 1952 and Krishnaveni *et al.* 1984).

Total sugar content was estimated by anthrone method (Hedge and Hofreiter 1962). Hydrolysis of sample was done with 2.5 N HCl for 3 hours and then cooled and neutralized. After centrifugation, different aliquots of 0.2 ml were used for analysis and volume was made up to 1 ml with distilled water. Four ml anthrone reagent was added to each tube including blank, mixed and heated for 8 minutes. Absorbance of green colour was measured at 630 nm after cooling the tubes. From the standard curve, sugar content was calculated and expressed in terms of percentage.

RESULTS AND DISCUSSION

Physical changes in the extracted sap of wild date palm are presented in Table 1. The results showed that the specific gravity of the sap changed from 1.041 during December to 1.047 and 1.052 during January and February respectively. The total soluble solids were maximum during February (14.33%) and decreased during January (12.73%) and December (11.43%).

pH, acidity and sugar/acid ratio

The pH, acidity and sugar/acid ratio of the wild date palm sap are given in Table 2. The sap extracted during

Table 1 Changes in physical characteristics such as specific gravity and total soluble solids of sap of wild date palm (*Phoenix sylvestris*)

Treatment	Specific gravity	TSS (%)
December	1.041	11.43
January	1.047	12.73
February	1.052	14.33
SEm	0.0024	0.58
SEd	0.0035	0.82
CD (P=0.05)	0.0071	1.69

Table 2 Biochemical characterization of sap of wild date palm (*Phoenix sylvestris*) with respect to pH, acidity and sugar/acid ratio

Treatment	pH	Acidity (%)	Sugar/acid ratio
December	4.67	0.25	44.84
January	6.75	0.04	325.47
February	4.46	0.33	42.93
SEm	0.06	0.01	19.54
SEd	0.08	0.01	27.64
CD (P=0.05)	0.17	0.02	56.71

January had the highest pH (6.75) and lowest acidity (0.04%) while sugar/acid ratio increased from 42.93 during February to 325.47 during January. Present results are in agreement with the results observed by Barh and Mazumdar (2008) (pH 7.40 in *Cocos nucifera* sap and pH 7.20 in *Phoenix sylvestris* sap). However sap of date palm (*P. dactylifera* L.) contains total acidity 0.06% to 0.20% (Chandrasekaran and Bahkali 2013) and 0.09% (Kulkarni *et al.* 2010).

Ascorbic acid, alcohol and phenol

The sap of *Phoenix sylvestris* contained high amount of ascorbic acid (vitamin C), viz. 18.75 mg/100 ml (December), 14.58 mg/100 ml (January) and 13.75 mg/100 ml (February). Parallel observations reported by Salvi and Katewa (2012) (ascorbic acid 12.75 mg/100 g) and Barh and Mazumdar (2008) (ascorbic acid 11.03 mg/100 ml) in wild date palm sap which is incredibly higher than the sap of *Cocos nucifera* (ascorbic acid 2.02 mg/100 g) and sap of *Borassas flabllifer* (ascorbic acid 3.56 mg/100 g) (Barh *et al.* 2005). However alcohol content was more (15.03 M/100 ml) during February than during January (10.10 M/100 ml) and December (6.12 M/100 ml). Also sap had high phenol content ranging from 67.90 mg/100 ml to 81.47 mg/100 ml which attributed for resistance to diseases, pests and other stresses (Table 3).

Carbohydrate

During December, the sap had reducing sugar (2.43%) lesser than non-reducing sugar but during February the reducing sugar increased to 10.91% as a result of which the non-reducing sugar decreased. Salvi and Katewa (2012) reported similar results with reducing sugar content 3.95 g/100 g in the date palm sap. The total sugar content was found higher during February (12.50%) than during January (11.72%) and December (11.37%) (Table 4). The estimated total carbohydrate contents are in agreement with the value reported by Barh and Mazumdar (2008) (13.80 g/100 ml in date sap).

Table 3 Changes in biochemical characteristics like ascorbic acid, alcohol and phenol of sap of wild date palm (*Phoenix sylvestris*)

Treatment	Ascorbic acid (mg/100 ml)	Alcohol (M/100 ml)	Phenol (mg/100 ml)
December	18.75	6.12	81.47
January	14.58	10.10	67.90
February	13.75	15.03	71.33
SEm	0.97	1.00	6.69
SEd	1.37	1.42	9.46
CD (P=0.05)	2.82	2.91	19.42

Table 4 Carbohydrate concentration of sap of wild date palm (*Phoenix sylvestris*)

Treatment	Reducing sugar (%)	Non reducing sugar (%)	Total carbohydrate (%)
December	2.43	8.93	11.37
January	3.58	8.14	11.72
February	10.91	2.90	12.50
SEm	0.71	0.47	0.48
SEd	1.00	0.66	0.69
CD (P=0.05)	2.06	1.36	1.42

The present study concludes that the sap of *Phoenix sylvestris* may be considered as a healthy and nutritious drink which provides a wide range of essential nutrients which help to add potential health benefits to human kinds. Therefore, wild date palms warrant more research and scientific intervention for its further improvement and to sustain rural economy of the country.

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