



## Assessment of yield and nutritional composition of fruit of wild date palm (*Phoenix sylvestris* Roxb.) cultivars

A.M. Swaraz<sup>1\*</sup>, Mohammed A. Satter<sup>2</sup>, Shamima Khan Sumi<sup>1</sup>

<sup>1</sup>Department of Genetic Engineering and Biotechnology, Jessore University of Science and Technology, Jessore – 7408, Bangladesh

<sup>2</sup>Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh

**Key words:** Wild date palm fruit, *Rutab* stage, Yearly fruit yield, Fruit pulp percentage, Fruit nutritional contents.

<http://dx.doi.org/10.12692/ijb/11.4.85-91>

Article published on October 18, 2017

### Abstract

Present study was conducted to estimate yearly fruit yield and subsequent analysis of nutritional contents of fruits of wild date palm at *Rutab* stage of fruit development. In this regard predominantly available five wild date palm cultivars were selected. It was found that studied wild date palm produced 31.50- 34.00 kg year<sup>-1</sup>per plant of fresh fruit. Fruit production greatly reduced in tapped plants which could be due to the preparation of taping surface for palm sap collection. It was also found that studied cultivars contain 49.04 - 51.60 % of fruit pulp. Nutrition composition analysis showed that fruit contain good amount of crude protein which was 3.12 - 3.55 g 100g<sup>-1</sup>, less amount of crude fat 0.45 - 0.61 g 100 g<sup>-1</sup> and high amount of sugar 41.65 – 47.41 g 100 g<sup>-1</sup> on dry weight basis. The analysis also showed that it contain adequate amount of crude fiber which was 12.45 - 13.87 g 100g<sup>-1</sup> (dry weight) and also yielded good amount of ash with 4.27 - 6.29 g 100 g<sup>-1</sup> (dry weight). The ascorbic acid content was found between 11.88- 20.75 mg 100g<sup>-1</sup>.The obtained results suggest that wild date fruit, which contain good amount of nutritional properties could be used as vital nutrient source of the region.

\* Corresponding Author: A.M. Swaraz ✉ [a.m.swaraz@gmail.com](mailto:a.m.swaraz@gmail.com).

## Introduction

Wild date palm (*Phoenix sylvestris Roxb.*) is a monocotyledonous, dioecious, C<sub>4</sub> perennial tall tree plant belongs to arecaceae family is a well-known source of economically important sweet sap and widely grown in South Asia, from Pakistan to Myanmar, across India, Nepal, Bhutan and Bangladesh (Krueger, 2011; Henderson, 2009; Barrow, 1998; Al-Mssallem, 2013). Millions of wild date palm are grown naturally in Bangladesh without damaging arable land and it grows naturally or is cultivated in fallow lands, around homesteads, farmland boundary, in the marginal lands along the roads and canals and also within the fields along with other crops and in harsh environment where relatively few other plants are able to grow (Rashid, 1991; Abedin and Quddus, 1991; Islam *et al.*, 2014). The wild date palm is priced due to its sweet sap and palm sap contain good nutrient supplement and rich in carbohydrate, protein, minerals (Calcium, Magnesium, Phosphorus, Iron, Potassium, Zinc, Copper, Sodium), Vitamin A, B-complex and Ascorbic Acid, thus it is a good source of healthy drink to alleviate malnutrition (Salvi and Katewa, 2012).

Wild dates are moderately sweeter and edible but remain underutilized due to lack of scientific information to make this fruit as potential nutritional source. Every year tons of wild dates wasted under the palm tree without utilization. Wild date fruits have enormous economic potential as nutritious food because of its huge volume of produced without regular agricultural practice. It could be alternative food source that can alleviate the food scarcity and malnutrition problem of the country. Therefore intensive scientific information and efforts are essential to valorize the wild date fruits as one of the key food security commodity of food diversification program.

The aim of this study was to develop knowledge on fruit yield volume and nutritional characteristics of fruits of commonly available wild date cultivars grown in western districts of Bangladesh. This study will shed light in terms of the quantity of yearly fruit

yield, fresh pulp amount, protein, lipid, fiber, ash, sugar and ascorbic acid contents of five wild date cultivars.

## Materials and methods

### *Collection of wild dates and fruit pulps*

Wild date fruits were collected from five morphological distinct wild date fruit producing plants hence denotes as five cultivars and designated them as Cv<sub>1</sub>, Cv<sub>2</sub>, Cv<sub>3</sub>, Cv<sub>4</sub> and Cv<sub>5</sub> (Fig.1). All of the plants were approximately 20 years of age. Mature fruits of the wild date palm of various cultivars were collected from spikelets at the *Rutab* stage (when fruits bitterness decreased and increased its sweetness, tenderness and become succulent, Samarawira, 1983; Ghnimi, *et al.*, 2017). The weight of the fresh wild date fruits were measured immediately after collection. Pulp was separated from seeds of the fruits and their weights were separately measured to obtain pulp percentage.

### *Sample preparation for chemical analysis*

Freshly prepared fruit pulps were dried in a drier at 55°C for 60 hours. The dried pulp sample was measured for dry weight and subjected to grinding until it turned into fine powder by grinder. The prepared powder of date samples were used for chemical analysis following the standard food analysis methods described in the Association of Official Analytical Chemists (AOAC, 2005).

### *Determination of total protein*

The total nitrogen was determined following the micro Kjeldahl method (AOAC, 2005). Then the total crude protein was calculated by multiplying the corresponding total nitrogen content by a conventional factor of 6.25. Briefly, powdered sample (1gm) was digested with digestion tablets and H<sub>2</sub>SO<sub>4</sub> in the Kjeldahl apparatus. The Kjeldahl tube was then placed to the distillation chamber followed by the addition of sufficient NaOH solution into the tube. The distilled solution was collected to a conical flask containing 2% boric acid with mixed indicator. Then the nitrogen in boric acid solution was titrated against 0.1 N HCl until the color become purple.

Percentage of nitrogen (N) was calculated using the equation as described Satter *et al.*, 2016.

#### *Determination of total crude fat*

The total crude fat was determined from dried date powder using petroleum ether by Soxhlet extraction method (AOAC, 2005). In this method, 10 gm of powdered sample was placed in Soxhlet apparatus and standard amount of petroleum ether was added to solubilize fat. The soxhlet was then placed in a water bath for the extraction of fat. After 16 hours of extraction the fat and ether were separated by rotary evaporation. Then the fat was transferred into a weighed conical flask and heated on a hot plate for few minutes to complete the evaporation of the remaining ether. Finally, the conical flask was kept in an oven at 100°C for few hours and subjected to total fat measurement using the following formula.

$$\text{Crude fat (\%)} = \frac{\text{Weight of fat in sample}}{\text{Weight of dry sample}} \times 100$$

#### *Determination of crude fiber*

Ten gram of dried powder sample was defatted with ethanol acetone mixture. Then the experiment was carried out using the standard method as described by Satter *et al.*, 2016.

$$\text{Crude fiber (\%)} = \frac{\text{Weight of residue} - \text{weight of ash}}{\text{Weight of sample}} \times 100$$

#### *Measurement of ash*

Ash content was determined by combusting the wild date sample in a muffle furnace according to the method of AOAC (2005) described by (Satter *et al.*, 2016). Five grams of the powdered sample was placed in a crucible, ignited in a muffle furnace at 600°C for 6 hours. The sample was then cooled, transferred into desiccators and weighed at room temperature to get the weight of the ash.

$$\text{Ash content (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

#### *Determination of reducing sugar*

Powdered sample (5g) was boiled with 50 % ethanol in a steam bath for 1.5 hours and left overnight at room temperature. Ethanol (95%) was added to the

samples, mixed thoroughly and allowed to settle. The samples were then filtered, and the ethanol was evaporated to a volume of approximately 20 ml in a water bath. The clearing agent lead acetate solution was added and kept for 10 minutes. The necessary amount of sodium oxalate solution was added to remove the excess lead. They were allowed to stand for 45 minutes and the volume was made up to 250 ml with distilled water and filtered. Mixed Fehling's solution of 10 ml was taken into a conical flask. A burette was filled with the clarified sample solution and running it to the conical flask to reduce the Fehling's solution. The content of the flask was heated to boil, add two drops of methylene blue indicator and continued the flow of clarified sample from burette to complete the titration.

The percentage of reducing sugar was calculated by the following formula:

$$\begin{aligned} \text{mg of total reducing sugar per 100 ml} &= \frac{\text{factor} \times 100}{\text{titre}} \\ \% \text{ of total reducing sugar} &= \frac{\text{mg/100 ml} \times \text{dilution factor} \times 100}{\text{Weight of sample} \times 1000} \end{aligned}$$

The factor is obtained from the invert sugar table by Pearson, 1976.

#### *Determination of total sugar*

Powdered sample (5 g) was boiled with 50 % ethanol in a steam bath for 1.5 hours and left overnight at room temperature. Ethanol (95%) was added to the samples, mixed thoroughly and allowed to settle. The samples were then filtered, and the ethanol was evaporated to a volume of approximately 20 ml in a water bath. The clearing agent lead acetate solution was added and kept for 10 minutes. The necessary amount of sodium oxalate solution was added to remove the excess lead. They were allowed to stand for 45 minutes and the volume was made up to 250 ml with distilled water and filtered. Clarified solution (20 ml) was transferred to a 100 ml flask. 5 ml 1N HCl was added into the flask. This solution was then boiled for 30 minutes. After cooling, 2 - 3 drops of phenolphthalein was added and the contents were neutralized with NaOH. The solution was filtered and the volume was made 100 ml. The total sugar was

calculated by the titrimetric method using Fehling solutions following the formula:

$$\text{mg of total sugar per 100 ml} = \frac{\text{factor} \times 100}{\text{titre}}$$

$$\% \text{ Total sugar} = \frac{\text{mg/100 ml} \times \text{dilution factor} \times 100}{\text{Weight of sample} \times 1000}$$

The factor is obtained from the invert sugar table by Pearson, 1976.

#### Determination Sucrose

After determination of total sugar and reducing sugar sucrose percent is determined following the formula  
 $\% \text{ of Sucrose} = (\% \text{ of total sugar} - \% \text{ of reducing sugar}) \times 0.95$

#### Determination of ascorbic acid

Ascorbic acid content in wild date was determined by the official method of 2, 4, dichloroindophenol titrimetric method described in AOAC (AOAC 2005). In a brief, 5g of powdered sample was added to 3% HPO<sub>3</sub> followed by filtration with Whatman 40 filter paper. The sample was the titrated with a dye (2, 6-

dichlorophenol indophenols and NaHCO<sub>3</sub>) until a faint pink color persists for 15 seconds. The ascorbic acid content in the sample was calculated as mg/100g using following formula:

$$a = \frac{bcd \times 100}{ef}$$

Where, a = ascorbic acid mg/100g, b = titration, c = dye factor, d = volume made up, e = aliquot of extract, f = weight of sample.

Standardization of dye:

$$\text{Dye factor} = \frac{\text{ml of std. ascorbic acid taken} \times \text{conc.}}{\text{ml of dye consumed}}$$

#### Statistical analysis

Collected data obtained from various parameters of date samples were subjected to statistical analysis using Microsoft XP Analysis Tool Pack software to compute standard error.

## Results and discussion

### Yearly fresh fruit yield and fruit pulp percentage

The fresh fruit yield and pulp contents of five cultivars of wild date palm at *Rutabstage* are shown in table 1.

**Table 1.** Dates yield and pulp content of 20 years old taped and non- taped female wild date palm cultivars. Data taken from ten plants of each cultivars and each value represents the mean  $\pm$  SE.

Date cultivar	Total fresh fruit yield (kg plant <sup>-1</sup> )		Fresh pulp yield (kg plant <sup>-1</sup> )		Fresh pulp percentage (wt %)	
	Taped	Non - Taped	Taped	Non - Taped	Taped	Non - Taped
Cv1	21.10 $\pm$ 1.41	32.50 $\pm$ 2.12	10.40 $\pm$ 1.41	16.77 $\pm$ 0.07	49.28 $\pm$ 1.12	51.60 $\pm$ 0.07
Cv2	19.70 $\pm$ 1.83	31.50 $\pm$ 3.53	9.56 $\pm$ 1.83	15.45 $\pm$ 1.91	48.52 $\pm$ 1.88	49.04 $\pm$ 0.35
Cv3	20.20 $\pm$ 2.15	34.00 $\pm$ 2.82	10.11 $\pm$ 2.15	17.22 $\pm$ 2.22	50.04 $\pm$ 1.98	50.64 $\pm$ 1.41
Cv4	21.00 $\pm$ 1.49	33.00 $\pm$ 4.24	10.13 $\pm$ 1.49	16.86 $\pm$ 2.39	48.23 $\pm$ 1.33	51.09 $\pm$ 0.07
Cv5	22.80 $\pm$ 1.51	31.50 $\pm$ 2.12	11.34 $\pm$ 1.51	16.12 $\pm$ 0.70	49.73 $\pm$ 1.13	51.20 $\pm$ 1.55

Variations of yearly fruit yield and pulp contents observed among cultivars and tap and non-taped plants. The highest amount of yearly fruit yield found from the cultivar Cv3 with 34 kg plant<sup>-1</sup> of its non-taped plants. All other cultivars also yielded more than 31 kgplant<sup>-1</sup> fresh fruit in non – tapped plants. There were variation of yearly total fruit yield also observed in taped plants. Taped plants of studied cultivars produced less amount of fruits compare to its non – taped counterparts and this reduction of yearly fruit yield were due to damage of inflorescences to prepare tapping surface to tap the tree for sap collection.

Usually wild date palm taped after clearing one side of its crown each year for the preparation of taping surface and this way half part of taped plant are unable to produce or lessly produce inflorescences. Regarding pulp percentage of studied cultivars, it was found that regardless taped and non-taped plants of all cultivars contained more than 48% of pulp.

The highest amount of pulp percentage observed in Cv1 with 51.60 % whereas lowest amount of pulp found from Cv2 with 49.04% of pulp on W/W basis. There were very less variation on pulp percentage observed between taped and non-taped plants of each cultivar. The remaining studied cultivars also yielded

pulp percentage with minimal differences between taped and non- taped plants. The observed results indicates that pulp percentage are not affect by taping of wild date palm. The differences of pulp percentage among the cultivars may be due to the genotypic specificity of each cultivars.

#### Crude protein content

The average crude protein contents at *Rutab* of the studied wild date fruit cultivars measured with the Kjeldahl method is given in Table 2. Variation of total crude protein found among the studied cultivars.

The highest amount of crude protein found from Cv3 with 3.55 g 100 gm<sup>-1</sup> and the lowest amount of protein detected from Cv2 which was 3.12 g 100 gm<sup>-1</sup>. As a non-crop fruit, obtained protein contents quite incredible because a classical dates at its *Rutabstage* contain 2.6 – 3.4 percent of protein (Sawayaet *al.*, 1983).

#### Crude fat content

The obtained result of crude fat from dry fruit pulp at *Rutabstage* of studied five wild date cultivars summarized in table 2.

**Table 2.** Nutritional composition g 100g<sup>-1</sup> (dry weight) and ascorbic acid contents mg 100g<sup>-1</sup> (dry weight) of dry mature wild dates pulp at *Rutab* stage. Each cultivars contents ten plants and analyzed in triplicates. Each value represents the mean ± SE.

Date cultivars	Fruit pulp							
	Crude protein	Crude fat	Sugar			Ash	Crude fibre	Ascorbic acid
			Reducing sugar	Sucrose	Total sugar			
Cv1	3.22 ± 0.43	0.61 ± 0.12	41.29 ± 0.87	0.82 ± 0.06	41.65 ± 0.51	5.18 ± 1.70	13.12 ± 1.12	11.88 ± 1.45
Cv2	3.12 ± 0.18	0.45 ± 0.11	42.92 ± 0.52	0.56 ± 0.26	43.26 ± 0.62	6.29 ± 2.88	12.84 ± 1.43	19.00 ± 2.18
Cv3	3.55 ± 1.04	0.51 ± 0.12	42.96 ± 0.58	0.80 ± 0.15	44.05 ± 0.70	4.27 ± 1.34	12.53 ± 1.54	17.81 ± 1.89
Cv4	3.42 ± 1.01	0.56 ± 0.13	46.78 ± 0.57	0.43 ± 0.25	47.41 ± 0.68	6.21 ± 1.10	13.87 ± 1.32	18.97 ± 1.34
Cv5	3.32 ± 0.56	0.53 ± 0.13	44.92 ± 0.85	0.43 ± 0.45	45.51 ± 1.15	5.35 ± 1.98	12.45 ± 1.56	20.75 ± 1.87

The fat contents in wild date fruits of the studied date cultivars ranges from 0.45 – 0.61 %.This similar lower fat amount also found in classical date fruit (Sawayaet *al.*, 1983; Ahmed *et al.*, 1995; Al-Hootiet *al.*, 1997).

#### Crude fiber content

The total crude fiber contents of fruits of five wild date cultivars at *Rutab* stage examined showed difference as presented in table 2. The obtained crude fiber amount of the studied cultivars were 12.45 - 13.87 g 100g<sup>-1</sup>. The maximum level of crude fibre obtained from Cv4 which was 13.87 g100gm<sup>-1</sup> and lowest amount found from Cv5 with 12.45 g 100 g<sup>-1</sup>. The obtained fiber is much higher in wild date fruits as compare to classical date of same developmental stage (Al-Hooti, 1997). Food which have more dietary fiber have more potent health benefit as dietary fiber intake reduced the risk of many disease (Anderson *et al.*, 2009). Therefore wild date fruit likely to be more health benefit compare to classical dates, at least due

to presence of more fibre content. This property can be included as another potentiality of wild date fruits to be used as potential healthy foodstuff.

#### Ash content

The ash contents of five wild date fruit at *Rutab* stage is shown in Table 2. It was found that all the cultivars contain good amount of ash which was 4.27 g 100 gm<sup>-1</sup> - 6.29 g 100 gm<sup>-1</sup>. This result indicate that wild date palm fruit would likely contain very high qualities essential minerals. Since ash content is an index to evaluate and grade the nutritive quality of foods (Pearson, 1976).The obtained data from ash analysis are more delectable with other study using classical data as material (Sawayaet *al.*, 1983; Ahmed *et al.*, 1995).

#### Sugar content

The sugar analysis results of studied five wild date cultivars at *Rutab* stage are presented in table 2. The major sugars in analyzed date fruit are reducing

sugars and sucrose. It was found that studied wild dates contain 41 – 47 g 100g<sup>-1</sup> total sugar in which predominantly present reducing sugar and very few percent (0.43-0.82 %) of sucrose. The highest amount of total sugar found from the Cv4 which was 47.41 g 100g<sup>-1</sup> and lowest from Cv1 with 41.65 g 100g<sup>-1</sup> of total sugar. Since this result obtained from *Rutabstage* and there is a possibility to increase to sugar amount in fruits because sugar contents usually increase until the *Tamrstage* in classical dates (Sawayaet *al.*, 1983).

The richness in reducing sugars of these studied cultivars indicates the existence of superior invertase activity, which considerably reduces its sucrose content and the obtained results are similar to that of classical date (Bouhlaliet *al.*, 2015; Sawayaet *al.*, 1983). The variation of sugar contents among cultivars could be due to the genotypic differences of the studied cultivars.



**Fig. 1.** *Rutab* stage fruit morphology of studied five wild date palm cultivars which were denoted as Cv1, Cv2, Cv3, Cv4, and Cv5. Left panel of each photo showing the whole fruit and right panel showing pulp (margin area) and seed of same cultivar.

#### *Ascorbic acid content*

The analysis of ascorbic acid was carried out for all the five cultivars and the result obtained are organized on Table - 2. Among the five studied cultivars, Cv5 contains highest amount of ascorbic acid with 20.75 mg 100g<sup>-1</sup> and Cv1 contains lowest amount of ascorbic acid with 11.88 mg 100 g<sup>-1</sup>. All the cultivars also contains high amount of ascorbic acid which were 19.00 mg 100 g<sup>-1</sup>, 18.97 mg 100 g<sup>-1</sup> and 17.81 mg 100 g<sup>-1</sup> in Cv2, Cv4 and Cv3 respectively.

When compared with the recommended dietary allowance for ascorbic acid as directed by National Institute of Health which is set at 75 - 90 mg per day for adults (NIH, 2017), the ascorbic acid content of wild dates at *Rutabstage* is very low. Similar observation also found in dates fruits which also contain less amount of ascorbic acid (Sawayaet *al.*, 1983).

### Acknowledgements

Authors are thankful to the Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR) for providing its analytical facilities.

### References

- Abedin MZ, Quddus MA.** 1991. Agro forestry system in Bangladesh with particular reference to economics and tenurial issue. In Mellink W, Rao YS, Mc Dickens D. (eds) Agroforestry in Asia and the Pacific, RAPA Publications 1995/5, Bangkok, Thailand.
- Ahmed IA , Ahmed AWK, Robinson RK.** 1995. Chemical composition of date varieties as influenced by the stage of ripening. Food Chem, **54**, 305-309.
- Al-Hooti S, Sidhu JS, Qabazard H.** 1997. Physicochemical characteristics of five date fruit cultivars grown in the United Arab Emirates. Plant foods for human nutrition, **50**, 01-113.
- Al-Mssallem IS, Hu S, Zhang X, Lin Q, Liu W, Tan J, Yu X, Liu J, Pan L, Zhang T.** 2013. Genome sequence of the date palm *Phoenix dactylifera* L, Nature Communication **4**, 2274.
- Anderson JW, Baird P, DavisJr RH, Ferreri S, Knudtson M, Koraym A, Waters V, Williams CL.** Health benefits of dietary fiber.2009. Nutrition Reviews **67**, 188 – 205.
- AOAC. International.** 2005. Official methods of analysis of AOAC international. 18th ed. Washington DC: Association of Official Analytical Chemists.
- Barrow SC.** 1998. A monograph of Phoenix L. (Palmae: Coryphoideae), Kew Bulletin, **53**, 513 – 575.
- Henderson AJ.** 2009. Palms of southern Asia, Princeton Univ. Press, Princeton, NJ.
- Ghnimi S, Umer S, Karim A, Kamal-Eldin A.** 2017. Date fruit (*Phoenix dactylifera* L.): An underutilized food seeking industrial valorization. NFS Journal **6**, 1- 10.
- Islam SA, Miah MAQ, Habib MA, Moula MG.** 2014. Performance of some mainland trees and palm species planted in the coastal islands of Bangladesh. Journal of Asiatic Society of Bangladesh, Science **40**, 9-15.
- Krueger RR.** 2011. Jain SM, Al-Khayri, JMD Johnson V (Eds.). Date Palm Germplasm, Date Palm biotechnology, Springer, Dordrecht, Heidelberg, London, New York, P, 313-336.
- NIH** (National Institute of health). 2017.
- Pearson D.** 1976. The chemical analysis of foods. 7th Edition, Churchill Livingstone, Edinburgh London and New Yor, 143-158.
- Rashid HR.** 1991. Geography of Bangladesh. University Press Limited: Dhaka, Bangladesh.J. Asiat. Soc. Bangladesh, Sci, **40**, 9-15.
- Salvi J, Katewa S.** 2012. Chemical composition and nutritive value of sap of *Phoenix sylvestris*Roxb .Electronic Journal of Environmental, Agricultural and Food Chemistry **11**, 578-583.
- Satter MMA, Mohammed, Khan MRL, Jabin SA, Abedin N, Islam MF, Shaha B.** 2016. Nutritional quality and safety aspects of wild vegetables consume in Bangladesh. Asian Pac J Trop Biomed **6**, 125–131.
- Sawaya WN, Khalil JK, Safi WN, Al-Shalhat A.** 1983. Physical and chemical characterization of three Saudi date cultivars at various stages of development. Can. Inst. Food Sei. Tehnol**16**, 087-091.