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Fruit physicochemical and antioxidant properties of wild date palm (*Phoenix sylvestris* Roxb.) accessions under the western part of West Bengal

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Abstract

The date palm is regarded as one of the most nutritious fruits of the arid zone. Fruits are eaten fresh as hard, ripe, or soft dates and are high in calories, iron, magnesium, vitamins and antioxidants. There is a high potential for expanding the area, production, and processing of date palm as a rain-fed fruit crop in the Western dry tract of West Bengal, where wild types grow abundantly without human intervention. Thus, the current study was conducted to investigate the physicochemical and antioxidative properties of fifteen wild date palm (*Phoenix sylvestris* Roxb.) genotypes (P-1 to P-15) from various locations in the Bolpur Sriniketan Block of the Birbhum district during the year 2022 in order to identify superior genotypes for commercial exploitation through a future breeding programme. The majority of the genotypes showed early-to-mid season fruiting with consistent fruit bearing. Date palm genotypes P-6, P-2, P-15, and P-12 had larger fruit sizes, higher pulp content, and higher TSS. The P-1 accession had the highest fruit productivity value (27 bunches/tree). Notably, at the rutab stage, accessions P-1, P-6, P-2, P-15, and P-12 had significant sugar content, indicating excellent fruit quality and antioxidant richness. These genotypes are recommended as ideal candidates for propagation and subsequent cultivation due to their outstanding characteristics.

Key words: Wild date palm, fruit morphology, biochemical profile, antioxidant

Introduction

The wild date palm (*Phoenix sylvestris* Roxb.) is the most common minor or underutilized fruit plant in the desert and dry areas. It is popularly known as the "Khajoor" or "Khejur" comes under the palm family Palmae which originated from the region around the Persian Gulf and has been grown in India, Africa and Spain antiquity (Tengberg, 2014). In India, it grows as the natural population on roadsides, in households, forests, and barren lands and is considered a common food for poor local people, mostly in tribal forest communities. The low pulp content, bigger-sized seed and less TSS and sugar force less commercial value of the fruit rather, it is mainly used as a source of "Neera" a drink (Sharma and Murlidhar, 2021). However, ripe fruits are very popular among poor villagers, tribal communities, and forest dwellers, fulfilling the demand for local fruit as well as nutrition. This underutilized or minor fruit is a diploid crop with chromosome number 2n =36 and bears staminate (male) and pistillate (female) flowers in axils of leaves of the previous year's growth on separate palms, causing it dioecious. This monocotyledonous plant bears strong, straight, unbranched stem growing to a very tall height. The bark is rough, greyish brown, young leaves and fronds are sharp. Leaves are palm-shaped, greyish, glaucous, sometimes bluish, pinnae 45 cm long or less, narrow stiff, borne in pairs, clusters or regular arrangement at an acute angle from the rachis, lower ones becoming spinous (Mariod *et al.*, 2017). Its root system is fasciculated and roots are fibrous. Each spikelet carries many tiny flowers, as many as 8,000 to 10,000 in female and more in male inflorescence. The male inflorescence is crowded at the end of the rachis, while branches of the inflorescence of the female cluster are less densely crowded at the end. The date fruit is a single, oblong, terete, one-seeded berry with a terminal stigma, a fleshy pericarp and a membranous endocarp (Salomón-Torres, 2021).

Date palm fruit is a nutrient-packed food rich in various carbohydrates (fructose and glucose), dietary fibers, proteins, minerals and thiamine, riboflavin, niacin and folic acid (Ioannis, 2010). It is also rich in minerals like calcium, iron, magnesium, selenium, copper, phosphorus, and potassium, including micronutrients (Aljaloud *et al.*, 2020). Due to multiple nutritional factors, date palm confers numerous potential health benefits. Date palms are also rich in phenolic compounds with high antioxidant activity and are potent sources of bioactivities against several bacterial pathogens (Al-Shwyeh, 2019). Different processed and value-added products such as sugar, starch, vinegar, juice and toffees are also prepared from date palm fruits (Salomón-Torres, 2021; Ashraf and Hamidi, 2011).

Phoenix sylvestris Roxb. is found throughout India, particularly in the plains of Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra and Gujrat. *Phoenix acaulis* (Gangali plum), *Phoenix. humilis* var. Boureiril Kunth and *Phoenix rupicola* are found in the sub-Himalayan tract from Kumaon to Bihar and Khasi hills; *Phoenix zeylanica* Trim and *Phoenix relinata* Jacq. in Eastern India, in Chotanagpur, Bihar and Western Ghats and *P. paludora* Roxb. and *Phoenix Pusilla* (wild date palm) in the coastal swamps of south India, Andmans and West Bengal (Al-Alawi *et al.*, 2017).

There is a high potential for increasing the area and production of various rainfed fruit crops in the Western Dry tract of West Bengal, particularly in the districts of Birbhum, Bankura, West

Burdwan and Purilia, where a considerable population of wild date palm is grown and used as natural resources by the local people. However, the nonavailability of promising varieties or clones and the lack of improved cultural practices of date palm are the main hindrance to date palm growing in West Bengal. Therefore, there is an urgent need for survey, characterization, collection, conservation and multiplication of elite types of wild date palms. Thus, the present research work was carried out to study morpho-biochemical and antioxidative characterstics of selected wild date palm genotypes under different Bolpur -Sriniketan block locations under the Birbhum district of West Bengal.

Materials and methods

The present study has been carried out, selecting fifteen diversified wild date palm genotypes of the same age group (20 to 25 years) from different villages under Bopur Sriniketan Block of Birbhum district of West Bengal. The GPS locations of all the date palm plants were recorded using hand-held GPS (Garmin GPS 12H).

Table 1. Location details of various wild date palm genotypes selected for the present study

Sl. no.	Date palm genotypes	Geographical location	
		Latitude	Longitude
1.	P-1	23.669758	87.661211
2.	P-2	23.674586	87.660483
3.	P-3	23.674676	87.660475
4.	P-4	23.673152	87.658335
5.	P-5	23.668926	87.666253
6.	P-6	23.669736	87.666602
7.	P-7	23.668617	87.666534
8.	P-8	23.668558	87.666504
9.	P-9	23.669756	87.670360
10.	P-10	23.669755	87.670367
11.	P-11	23.666056	87.672337
12.	P-12	23.667112	87.672284
13.	P-13	23.668212	87.662464
14.	P-14	23.667924	87.662468
15.	P-15	23.666339	87.673272

After studying the yield attributing characters at fruit maturity, a completely mature ripe bunch of fruit was brought to the laboratory of the Department of Horticulture and Postharvest Technology, Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal, India. Fruit physical parameters were recorded on site and plant samples *viz.*, bunch and fruit samples, were collected for further physical and biochemical analysis. The details of the experiment, the material used and the techniques employed for studies are as follows.

Fruit physical characters: The fruit morphological characters *viz.*, fruits and seed characters of the selected trees were recorded during the experiment tenure based on the descriptors given by the Protection of Plant Varieties and Farmers Rights Authority (PPV & FRA) Government of India. The bunch diameter was measured in mm as the mean diameter using a vernier calliper and its number of Bunch, the number of fruits and spikelet was determined by a standard chart. The spathe diameter of three spathes per genotype was measured at 5 cm from the base of the fruit with the help of a vernier calliper. The number of strands per bunch was obtained by counting the number of strands on each bunch within the bunch. The number of berries per strand was obtained by counting the number of berries on each strand within the bunch. The fruit length of three fruits from each replication was measured from the distal end to the proximal end of the fruit with the help of a measuring scale and the mean was worked out and expressed in millimetres. The fruit diameter of three fruits per replication was recorded at the widest point of the fruit using a measuring scale and the mean value was expressed in millimetres. Three randomly selected fruits from each replication were used for measuring the fruit weight. The weight was measured on a pan balance and the average fruit weight was calculated and expressed in grams. Data on seed length was recorded from three randomly selected seeds from each replication using a vernier calliper and their mean value was expressed in millimetres. Data on seed diameter was recorded from three randomly selected seeds from each replication using a vernier calliper at the widest point and their mean value was expressed in millimetres. Seed weight was measured on a simple pan balance and their mean weight was recorded and expressed in grams.

Fruit biochemical characters: Total soluble solids **(**TSS) content has been measured using a digital refractometer (0-32°Brix), the TSS of ripe fruit juice was calculated by placing a few drops of the juice on the prism and expressed in °Brix. The titration method was used to determine the titrable acidity (Rangana, 1986) taking 5 mL of juice (from 5g pulp) to which 2–3 drops of the phenolphthalein indicator were added, and the mixture was then titrated against 0.1 N NaOH. Acidity was determined with the titre value from the standard formula.

Total sugars were determined following the method as described in AOAC (1990). 50 mL lead-free filtrate was taken in a 100 mL volumetric flask to which 5 mL of concentrated HCl, mixed well and then kept for 24 hours at room temperature. The acid was then neutralized with NaOH using a drop of phenolphthalein as an indicator till the pink colour persisted for at least a few seconds. Then volume was made up to 100 mL. Total sugar were them estimated by taking this solution in a burrette and titrating it against standard Fehling's solution mixture A and B (1:1) using methylene blue indicator, taking brick red colour as the end point.

Reducing sugars were determined by adopting the method given by Lane and Eynon (1923). A combination of 2 mL each of Fehling's A and B with a small amount (40 mL) of distilled water was taken. One burette was taken and filled with the prepared sample up to zero, and then it was titrated against Fehling's solution in a heated environment until brick red colour precipitated. The burette reading was noted to calculate the value.

Ascorbic acid content was determined following the indophenol dye method as described in (Rangana, 1986). 100 mg of ascorbic acid was weighted and made up to 100 mL with 3.0% (HPO_3). One mL of this solution was diluted to 10 mL by adding 3.0% HPO_3. 52 mg of sodium salt of 2, 6- dichlorophenol- indophenols was dissolved in 150 mL of hot distilled water containing 42 mg sodium bicarbonate after cooling. It was diluted with 200 mL distilled water and stored in refrigerator and standardized every day. In 5 mL of standard ascorbic acid solution 5 mL of HPO_3 micro burette was filled with the dye solution. Standard ascorbic acid was filtrated against dye solution to a pink colour, which persisted for 15 seconds. An aliquot (10 mL) of the sample was taken and titrated against the standard dye to a pink colour end point, which persisted for 15 seconds. The ascorbic acid content of the sample was calculated using the formula.

DPPH antioxidant activity (%): Free radical scavenging activity was estimated using DPPH (2, 2-diphenyl-1- picrylhydrazy!) assay (Brand-Williams *et al.,* 1995). It is based on the measurement of the scavenging ability of antioxidants of stable DPPH radical. Sample preparation was done with 80% methanol. Sample extract (0.2 mL) was mixed with 2.5 mL of 0.0634 mM DPPH reagent and 0.3 mL acetate buffer (pH- 5.4) and shaken thoroughly. Reaction mixture was incubated for 30 minutes and then absorbance was recorded at 515 nm through spectrophotometer (T80+ UV/VIS spectrophotometer, PG instruments Ltd. UK). Percentage radical scavenging activity (RSA) will be calculated by: formula: RSA (%) = (Abs_0-Abs_1) 100/ Abs_0 where, Abs_0, was the absorbance of blank Abs_1, was the absorbance of the sample.

The data were analyzed to test the significance of differences between them through descriptive statistics and analysis of variance through Randomized Block Design (RBD) following the procedure suggested by Ronald A. Fisher (Gomez and Gomez, 1984).

Results and discussion

In the present study, 14 quantitative morphological and 6 physico-chemical characters were observed for 15 date palm germplasm. These observations are described under the following headings and subheadings:

Quantitative characters related to fruiting

Number of bunch per tree: Analysis of variance for the assessed trait showed significant differences for the number of the bunch among the investigated genotypes (Table 2). Among selected date palm genotypes, number of the bunch was highest in P-1 (27) followed by P-4 (18), P-12 (18), P-2 (12), P-10 (12) and P-6 (11) and the minimum in P-3 (3), P-5 (5), P-7 (6). The result corroborates well with the finding of Metwally *et al.* (2019).

Number of fruits per bunch: The number of fruits per bunch ranged from 58 to 645 (Table 2). The date palm genotypes P-1(645) produced the maximum number of fruits, followed by P-13 (548), P-10 (532), and P-12 (486) and it was lowest in P-7 (58) and preceded by P-6 (66), P-5 (87).

Table 2. The morphological quantitative traits in fruiting of wild date palm (*Phoenix sylvestris*Roxb.) genotypes

Accessions	No. of bunches/ tree	No. of fruits / bunch	No. of spikelet/ bunch	No. of fruits/ spikelet	Spadix girth (cm)
P1	27	645	81	28	21.55
P2	12	347	33	18	14.73
P3	3	343	68	23	19.02
P4	18	368	58	26	18.16
P5	5	87	62	22	22.31
P6	11	66	63	9	23.56
P7	6	58	28	31	21.02
P8	10	412	74	27	19.47
P9	14	120	68	23	26.39
P10	12	532	62	34	20.14
P11	3	437	61	29	23.85
P12	18	486	89	22	33.24
P13	8	548	67	32	18.72
P14	11	433	63	28	26.53
P15	8	428	72	19	28.87
Mean	11.06	354	63.26	24.73	22.50
S.Em	1.65	22.32	2.22	1.64	1.22
C.D.	6.39	87.15	8.63	6.38	4.73

Number of spikelets per bunch: The number of Spikelets per bunch ranged from 28 to 89 (Table 2). The date palm genotype P-12 (89) produced the maximum number of spikelets followed by P-1 (81), and P-15 (72), and it was counted as the lowest in P-7 (28), and preceded by P-2 (33), P-4 (58).

Number of fruits per spikelet: The number of fruits per spikelet varied from 9 to 34 (Table 2). The date palm genotype P-10 (34) produced the maximum number of fruits followed by P-13 (32), P-7 (31), and P-11 (29) and it was counted as the lowest in P-6 (9) and preceded by P-2 (18), P-15 (19).

Spadix girth: The data on spadix girth is given in (Table 2). The genotype varied statistically for this characters. The character's value varied from 14.73 to 33.24 mm. Genotype P-12 (33.24) revealed the highest width, followed by P-15 (28.87), and P-14 (26.53). The lowest spadix width was recorded in genotype P-2 (14.73), proceeded by P-4 (18.16) and P-13 (18.72). Soumaya *et al.* (2008) has also reported the variation of several vegetative parameters of date palm including the spadix characters in Mauritius condition.

Fruit morphological quantitative traits

Fruit length: Significant variations were observed among all the genotypes for fruit length (Table 3). The population mean of the character was 25.04 mm. The fruit length ranged from 23.20 to 28.65 mm. The fruit length was found as maximum in genotype P-6 (28.65 mm), followed by P-15 (28.25 mm) and P-12 (28.15). The lowest fruit length was observed in the genotype P-11 (23.20 mm), followed by P-4 (23.38 mm). These results are in conformity with the findings of Ahmed *et al.* (2021).

Fruit diameter: The diameter of the fruit was observed to vary considerably in different types of date palms (Table 3). The diameter of the fruit ranged from 11.66 mm to 16.15 mm. Higher fruit diameter have been observed in the accessions namely P-1 (12.93 mm), P-6 (16.15 mm), P-12 (15.12 mm) and P-15 (14.79

Table 3. Quantitative traits related to morphology of fruits of wild date palm (*Phoenix sylvestris* Roxb.) genotypes

Accessions	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Pulp weight (g)	Seed weight (g)	Seed length (mm)	Seed diameter (mm)	Cap length (mm)	Cap diameter
P1	25.09	12.93	1.89	1.11	0.76	17.59	8.16	3.31	7.32
P2	24.12	12.30	1.69	0.91	0.78	17.03	8.58	3.39	6.16
P3	24.00	11.84	1.89	1.08	0.80	17.46	8.44	3.39	6.54
P4	23.38	11.66	1.70	0.93	0.77	17.12	8.47	3.23	6.03
P5	24.80	11.98	1.77	1.00	0.77	17.11	8.24	3.65	6.69
P6	28.65	16.15	3.91	2.38	1.53	21.08	10.59	2.88	7.56
P7	23.97	11.77	1.83	0.98	0.85	16.98	8.63	3.61	6.34
P8	24.49	13.07	2.38	1.15	1.23	18.48	9.86	3.52	6.82
P9	24.04	11.63	1.82	1.01	0.81	17.02	8.36	3.58	6.49
P10	24.57	12.24	1.82	1.01	0.81	17.26	8.45	3.29	6.43
P11	23.20	11.43	1.68	0.97	0.70	16.90	8.09	3.40	5.83
P12	28.15	15.12	3.50	1.66	1.84	20.87	10.75	2.87	7.11
P13	23.66	11.74	1.53	0.80	0.72	17.22	8.03	3.51	6.14
P14	25.28	12.79	1.76	0.96	0.80	17.33	8.20	3.43	6.34
P15	28.25	14.79	3.64	1.70	1.94	21.8	11.15	3.69	7.88
Mean	25.04	12.76	2.19	1.18	1.01	18.08	8.93	3.38	6.64
S.Em(	0.39	0.28	0.11	0.07	0.05	0.41	0.21	0.08	0.16
C.D	1.12	0.81	0.30	0.20	0.14	1.17	0.61	0.23	0.46
Range	23.2-28.65	11.66-16.15	1.53-3.91	0.8-1.7	0.7-1.94	16.9-21.8	8.03-11.15	2.87-3.69	6.03-7.88

mm). Findings of Alqahtani *et al.* (2023) unveiled congruent outcomes concerning the fruit diameter of the *Phoenix dactylifera*, spanning a range of 8.94 to 30.37 mm. Additionally, the present study on *Phoenix sylvestris* unveiled resemblances among specific genotypes. These findings signify the potential of forthcoming breeding programs to concentrate on these parameters, as they hold great promise in providing valuable insights.

Fruit weight: Some of the genotypes showed significant variability in fruit weight (Table 3). The character's population mean was 2.19 g. The weight of the fruit varied from 1.53g to 3.91g. The genotype P-6 had the highest fruit weight (3.91 g), followed by P-15 (3.64 g), P-12 (3.50 g), and P-8 (2.38 g), however, these genotypes differed noticeably from the others. P-13, followed by P-4, had the lowest fruit weight (1.53 g).The documented findings, in accordance with Ahmed *et al.* (2023) where they presented that "Shado 4.17," unveil that Begum Jangi and Shado 4.44 g exceed the weight of fifty genotypes of *Phoenix dactylifera*.

Fruit pulp weight: The pulp weight of fruit varied significantly between 0.80 and 2.38 gm in different selected genotypes (Table 3). The maximum weight of the pulp was observed in P-6 (2.38 g) and the minimum in P-13 (0.80 g). The fruit pulp weight of *Phoenix sylvestris*, unlike that of *Phoenix dactylifera*, varies due to factors such as wild genotypes, agronomical influences, and environmental conditions. Alaida and Aldhebiani (2023) highlighted this range to be between 5.71g and 12.12g in their study. However, in the current research, the observation of fruit pulp weight aligns with that of cultivable date palm, which spans from 3.73g to 18.87g. This similarity is attributed to the fact that *Phoenix sylvestris* as reported by Ahmed *et al.* (2021). Moreover differences in the genotypes attributed to genotypic makeup of wild date palm plants and varying growing conditions which was also confirmed by different genotypic markers (Ahmed *et al.*, 2021).

Seed weight: Significant variations were observed among genotypes for these traits, with values ranging from 0.7 to 1.94 g (Table 3). The overall mean for this trait was 1.01 g. Notably, the seed weight of genotype P-15 exhibited the highest value (1.94 g), showing a significant difference from other genotypes except for P-12 (1.84 g). Following closely were P-6 (1.53 g) and P-8 (1.23 g). Conversely, the lowest seed weight was recorded in P-11 (0.70 g), preceded by P-13 (0.72 g) and P-1 (0.76 g). These findings align well with the findings of Hanane and Halima (2020) on cultivable date palms, where they reported seed weights ranging from 0.70 to 1.54 g. The current research on *P. sylvestris* similarly observes seed weights, reflecting its close affiliation with the Arecaceae family. However, Sakr *et al.* (2010) reported considerably higher fruit seed weight and studies on *P. dactylifera* have reported a range of 1.56 to 2.62 g. The findings from the present research on *P. sylvestris* and the recorded values hold significant importance.

Seed Length: The study revealed a general range of seed length spanning from 16.98 to 21.80 mm across the genotypes, as presented in Table 3. Among the genotypes, the shortest stone length was observed in P-11 (16.90 mm), followed by P-7 (16.98 mm) and P-9 (17.02 mm), while the longest stone length was recorded in P-15 (21.8 mm), followed by P-6 (21.08 mm) and P-12 (20.87 mm).The similarity in fruit seed length between *P. dactylifera* and *P. sylvestris*, owing to their shared family and germplasm, ranges from 1.75 to 3.4 mm, as reported by Alaida and Aldhebiani (2022).

Seed diameter: Seed diameter showed a wide range of variations from 8.03 to 11.15 mm and 8.93 mm was measured as the mean value for this parameter in the present experiment (Table 3). The maximum seed diameter was observed in genotypes P-15 (11.15 mm), followed by P-12 (10.75 mm), P-6 (10.59 mm) and P-8 (9.86 mm), while the minimum seed width was observed in P-13 (8.03 mm), preceded by P-11 (8.09 mm) and P-14 (8.20 mm).The finding aligns with the research conducted by Sakr *et al.* (2010), which reported a range of *P. dactylifera* fruit seed diameters from 2.03 mm to 10.17 mm. The findings of Bashah (1996) have also the conformity with the findings of the present experiment regarding the seed diameter.

Fruit cap length: The fruit cap length of the selected genotype was found as the longest of 3.69 mm in P-15, followed by 3.65 mm in P-5, 3.61 mm in P-7, 3.58 mm in P-9 and the least in P-12 as 2.87 mm (Table 3).

Fruit cap diameter: The average fruit cap diameter was recorded as the maximum as of 7.88 mm in P-15, followed by 7.56 mm in P-6, 7.32 mm in P-1, and 7.11 mm in P-12 (Table 3). All these genotypes differ considerably from P-15.

Fruit Bio-chemical Parameters

Total soluble solids (TSS) content: The total soluble solids content of ripe fruit of wild date palm genotypes varied from 31.3 to 36.6 Brix, with 34.03 Brix in general (Table 4). The lowest TSS content was observed in P-3 (31.3 Brix), preceded by P-11 (31.7 Brix) and P-4 (32.2 Brix).The highest TSS content was observed in accession P-2 (36.60 Brix), closely followed by accession P-6 (36.40 Brix) and accession P-15 (36.30 Brix). Based on the findings of Sedra *et al.* (1998), the total soluble solids content of ripe fruit from *Phoenix sylvestris* measuring 72.69 °Brix does not exhibit significant consistency, likely attributed to the diverse nature of wild plants. Moreover, the present research indicates dissimilarities in the biochemical results compared to those reported by Sadiq *et al.* (2013) and Mo *et al.* (2015), which can be attributed to genetic and environmental diversity.

Acidity: The percentage of total acidity revealed a variation from 0.56% to 1.13% with a mean of 0.84%, and it exhibited significant variation among the wild date palm in the present study (Table 4). Acidity percentage was observed as a minimum in P-5 (0.58%), followed by P-4 (0.59%), P-7 (0.59%), and P-8 (0.59%), which both have the same value of 0.59%, whereas the maximum total acidity percentage was expressed by the accession P-2 (1.13%), P-3, and P-5, which have the same value of 1.05%. The reported titrable acidity by Merghany and Daen (2013), Sadiq *et al.* (2013), Mo *et al.* (2015), Farag *et al.* (2014) and Qadri *et al.* (2016) is deemed insignificant, primarily influenced by genetic and environmental factors.

Total sugar content: The percentage of total sugar also revealed considerable variation from 35.9 to 41.4% with an average of 38.97% (Table 4).The total sugar percentage was extremely low in P-3 (35.9%) preceded by P-11 (36.7%), and P-4 (37.2%), whereas Jain *et al.* (2018) provided a corresponding analysis regarding the

proximate and sugar compositions of date palm fruits. Their report highlighted the presence of fructose (22.8 mg), glucose (22.3 mg), and maltose (33.7 mg) in similar concentrations. Additionally, the total sugar contents of *P. sylvestris* fruits were found to range from 44% to 88%, as observed by Hadrami and Hadrami (2009), indicating the influence of genetic factors.

Reducing sugar content: The mean data of this character revealed significant differences among the genotypes and the reducing sugars value ranged between 29.5 to 35.70% (Table 4). The general mean of the character was 32.02%. The highest reducing sugar was found in the genotype P-2 (35.7%), followed by P-6 (34.93%), P-1 (33.23%) and P-12 (33.03%), whereas the lowest reducing sugar was observed in the fruits of genotype P-11 (29.50%), preceded by P-3 (29.93%) and P-10 (30.36%). Sakr *et al.* (2010) reported that reducing sugar contents in fruits of *P. sylvestris* range from 16.34 to 51.00 % according to these reported values reducing sugar contents are statistically similar to the present experiment. Amira *et al.* (2011) quantified the sugars from Tunisian date cultivars and reported similar findings of reducing sugars at all developmental stages. Values of reducing sugars in our results were similar to those cultivars reported by Rastegar *et al.* (2012).

Table 4. Fruit biochemical parameters and antioxidant activity of wild date palm (*Phoenix sylvestris* Roxb.) genotypes

Accessions	TSS (Brix)	Titrable Acidity (%)	Total Sugar (%)	Reducing Sugar (%)	Ascorbic Acid (mg/100g)	Anti-oxidant (%DPPH)
P1	34.9	0.56	39.2	33.23	3.62	55.41
P2	36.6	1.13	41.0	35.70	2.75	70.74
P3	31.3	1.05	35.9	29.93	3.62	52.38
P4	32.2	0.59	37.2	30.83	4.41	90.39
P5	34.9	0.58	40.2	32.70	2.30	81.75
P6	36.4	1.05	41.4	34.93	3.52	87.88
P7	33.5	0.59	38.7	32.06	3.85	89.57
P8	32.8	0.59	37.8	30.96	2.74	89.37
P9	34.2	0.99	39.2	32.03	3.65	83.01
P10	32.4	0.98	37.6	30.36	4.17	87.99
P11	31.7	0.90	36.7	29.50	2.46	91.85
P12	35.0	0.82	40.1	33.03	2.65	97.54
P13	34.1	0.81	39.4	31.00	2.49	81.77
P14	33.7	0.92	38.7	31.40	4.12	80.16
P15	36.3	0.99	41.0	32.66	3.85	93.00
Mean	34.03	0.84	38.97	32.02	3.35	82.19
S.Em.	0.92	0.07	0.89	0.81	0.10	1.34
C.D.	2.63	0.19	2.54	2.31	0.28	3.82
Range	31.3-36.6	0.56-1.13	35.9-41.4	29.5-34.93	2.3-4.41	52.38-97.54

Ascorbic acid content: The ascorbic acid contents in ripe fruits varied from 2.30 mg/100 g to 4.41 mg/100 g, with 3.35 mg/100 g in general (Table 4). The lowest ascorbic acid content was observed in P-5 (2.30 mg/100 g), preceded by P-11 (2.46 mg/100 g) and P-13 (2.49 mg/100 g). The highest ascorbic acid content was observed in accession P-4 (4.41mg/100gm), very closely followed by P-10 (4.17mg/100gm) and P-14 (4.12mg/100gm). Swaraz *et al.* (2021) observed that the ascorbic acid content in *Phoenix sylvestris* fruits surpasses other observations, primarily influenced by genetic diversity and environmental factors, rather than wild, environmental, or genetic diversity alone. This finding aligns well with the results of the present study. Similarly, Olabinjo *et al.* (2022) and Assirey (2015) reported ascorbic acid contents in the fruit pulp of *P. sylvestris* and *P. dactylifera* at close conformity of the findings of present experiment. These variations in ascorbic acid content can be attributed to genetic diversity, fruit oxidation, differing developmental stages, and environmental conditions.

Antioxidant activity (DPPH radical scavenging activity)

The percentage of total antioxidants revealed a variation from 52.38 to 97.54% with a mean of 82.19 % and it exhibited significant variation (Table 4). The antioxidant percentage was observed as a minimum in P-3 (52.38 %), preceded by P-1 (55.41%), P-2 (70.74), whereas the maximum total antioxidants percentage was expressed by the germplasm P-12 (97.54%), preceded by P-15 (93.00%) and P-11 (91.85%). In their study, Zihad *et al.* (2021) documented a remarkable antioxidant content of 96.41% in ripe fruits of *P. sylvestris*, indicating significant antioxidant activities. The results demonstrate that MEPS (presumably a test substance or extract) has the ability to counteract the harmful effects of free radicals generated by DPPH, thus ensuring the preservation of human health (Hammad *et al.*, 2015). Previous studies have also reported that plant phenolics and flavonoids exhibit notable antioxidant activities (Allaith, 2008 and Hamad *et al.*, 2015).

Our study on fifteen locally selected wild date palm accessions from the western dry tract of West Bengal revealed a significant diversity in genotypes. Qualitative metrics indicate that fruit quality surpasses industry norms, with genotypes P-6, P-12, P-1 and P-15 standing out as diverse. These genotypes, excelling in fruit weight, length, diameter, pulp content, and physico-chemical qualities, emerge as ideal candidates for widespread cultivation and multiplication.

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