

Short Communication

Elemental Composition of Date Palm (*Phoenix dactylifera* L.) Using Energy Dispersive X-Rays Spectrometry

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Abstract. In the present study, date palm (*Phoenix dactylifera* L.) including fruit and pit (Mashkeel variety) was collected from a local market in Peshawar, Pakistan and analyzed using EDX spectrometry. The results showed the presence of various important elements such as O, C, K, Cl, Ca, S, Mg, Fe, Co and Si in date palm fruit and pit. Sufficient amount of oxygen (>54 wt.%) and carbon (>42 wt.%) were determined in the date palm, which is the evidence of the presence of nutritionally enriched constituents. Similarly, the mineral elements including Na, Ca, Mg, K, Ni, Si, Co, Fe and Mo were present in sufficient quantities.

Keywords: date palm, EDX spectrometry, elemental composition, essential nutrients, Pakistan

The date palm (*Phoenix dactylifera* L.) is usually grown in hot, arid and desert regions of the world. At present, more than 2000 different cultivars of date palm are known to exist all over the world, but only a few important ones have been evaluated for their agronomic performance and fruit quality. The fruit of date palm is composed of fleshy pericarp and seed and is well known as staple food. The fruit undergoes several changes during various stages of growth and development. Different varieties of dates growing in various countries have been studied for chemical composition and nutritional quality (Mohammadzai *et al.*, 2010a & b; Williams *et al.*, 2005; Al-Hooti *et al.*, 1997; Al-Showiman, 1990; Sawaya *et al.*, 1983).

The date is considered an important cash crop and a good source of foreign exchange earnings. Pakistan is the fourth largest dates producing country in the world which grows different varieties of dates. Total cultivated area of all types of dates in the country exceeds 78.1 thousand hectares, which produce over 630 thousand tones dates annually (Mohammadzai *et al.*, 2010a & b; Ihsanullah *et al.*, 2005). The effect of gamma irradiation, and colourless and coloured polyethylene packing on the quality and shelf life of Pakistani dates were studied by Mohammadzai *et al.* (2010a) and Ihsanullah *et al.* (2005). They found that irradiation caused minor losses in the tested parameters (moisture, proteins, fibres and fats) of controlled and irradiated packed samples. Similarly,

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Baloch and co-workers improved the quality of Dhakki dates of Pakistan during its various growing stages using the different physio-chemical processes (Saleem *et al.*, 2005; Baloch *et al.*, 2003). Recently, mineral composition of Pakistani dates was also reported using atomic absorption spectrophotometry (Mohammadzai *et al.*, 2010b). The Mashkeel variety of dates grown in Pakistan have not been subjected to elemental analysis using EDX spectrometry so far. The current study, therefore, was aimed at assessing the level of various elements present in the date palm fruit and pit.

Among various analytical techniques, EDX spectrometry is highly proficient for the elemental analyses of samples of diverse nature. The method is non-destructive and is more advantageous in multi-elementary analysis as compared to other existing methods, in the ease of sample preparation and analysis as it requires no chemical treatment or separation of the sample constituents. Although, this technique has been extensively used for elemental analyses of samples of biological and environmental importance (Khan *et al.*, 2009; Khan *et al.*, 2006), however, in the present study, this modern and roused analytical technique has been applied probably for the first time, to determine the elemental composition of date palm fruit and pit.

Date palm (Mashkeel variety) was collected from a local market of Peshawar, Pakistan, in the same form as marketed. For each sample, ten date palm fruits and pits were collected in properly cleaned polyethylene

bags in triplicate (Mohammadzai *et al.*, 2010 a & b) and brought to the laboratory. During the sampling processes and transportation and storage, all the precautionary measures were observed to avoid contamination. EDX spectrometry was performed using energy dispersive X-rays spectrometer (INCA-200, Oxford Instruments, UK). For this purpose, the dried powder samples were mounted on the sample stubs and coated with gold foil using gold coating machine (JSM-420, JEOL, Japan). The samples were then analyzed by EDX spectrometer (Khan *et al.*, 2009; Khan *et al.*, 2006). Each sample was analyzed in triplicate and reported as the mean \pm S.D. (standard deviation) on dry weight basis, in wt.%.

The important elements identified in date palm fruit were O, C, K, Cl, Ca, S, Mg and Si (Fig. 1, Table 1) while O, C, K, Fe, Cl, Si Ca, S, and Co were found in date palm pit (Fig. 2, Table 1). The elements were also determined quantitatively. In the fruit, among all the investigated elements, O was in the largest quantity, followed by C. The rest of the elements were in lower concentrations (Table 1).

In the date palm pit, the amounts of O and C were the largest. Next were the concentrations of K, Fe, Cl, and Si while Ca, S, and Co were in traces. Thus both in the date palm fruit and pit, higher and comparable amounts of O and C were recorded (Table 1). However, the amount of K in the fruit samples was smaller than the pit samples while the levels of the Cl, Ca, and S were almost the same in both the samples. The concentration of Si in the pit samples was slightly higher than the fruit samples. Mg was found only in the fruit while Fe and Co were only in the pit samples. This means that date palm fruit and pit accumulate different quantities of some mineral elements such as K, Si, Mg, Fe and

Co. Similar trend was reported in the previous study (Mohammadzai *et al.*, 2010b).

It is well-known that health depends upon the organized state of elements in the body and their imbalance causes disease (Khan *et al.*, 2009; Khan *et al.*, 2008). Due to the presence of higher contents of C and O, the date palm shows abundance of various nutritive constituents such as carbohydrates, proteins, fats, fibres, vitamins, etc. as reported previously (Mohammadzai *et al.*, 2010a; Ihsanullah *et al.*, 2005; Al-Hooti *et al.*, 1997). Hydrogen was not found in both samples, as this element cannot be detected with EDX spectrometry (Khan *et al.*, 2009; Khan *et al.*, 2006). Thus it is concluded that the date palm possesses good nutritional qualities. In addition, the presence of various macro- and microelements (K, Ca, Mg, Fe and Co) further increases its nutritional importance. The results are in good agreement with the previous findings (Mohammadzai *et al.*, 2010b; Al-Hooti *et al.*, 1997). It was also reported that the

Table 1. Elemental composition of date palm fruit and pit

Elements	Concentration (wt. %) in fruit	Concentration (wt. %) in pit
O	54.84 \pm 1.98	55.77 \pm 1.35
C	43.83 \pm 1.01	42.23 \pm 1.10
K	0.66 \pm 0.08	0.81 \pm 0.02
Fe	-	0.49 \pm 0.01
Cl	0.28 \pm 0.01	0.32 \pm 0.01
Ca	0.10 \pm 0.001	0.09 \pm 0.001
S	0.10 \pm 0.003	0.09 \pm 0.00
Mg	0.09 \pm 0.00	-
Si	0.09 \pm 0.00	0.13 \pm 0.005
Co	-	0.05 \pm 0.00

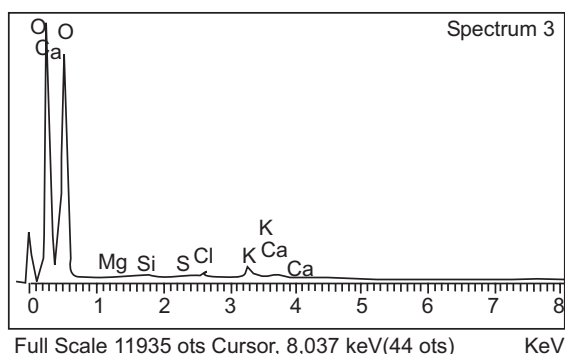


Fig. 1. A representative EDX spectrum of date palm fruit (Full scan).

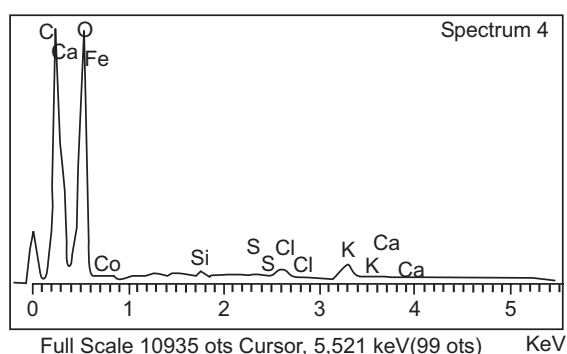


Fig. 2. A representative EDX spectrum of date palm pit (Full scan).

mineral contents of dates grown in the United Arab Emirates decreased progressively as the fruit matured (Al-Hooti *et al.*, 1997). Williams *et al.*, (2005) determined the levels of selected metals (Ag, Al, Ba, Be, Ga, La, Mo, Se, Si, Tl, and V) in the soil, fruit, and leaves of date palm (Fard cultivar) grown in the Sultanate of Oman. Similarly, Al-Showiman (1990) found highly significant amount of Ca, while K, Na, and Mg comes in to second place in the Saudi Arabian dates. Sawaya *et al.* (1983) have also reported a wide variation in the mineral contents of Saudi Arabian date cultivars. These studies show that the mineral contents of the date fruits may be influenced by the level of soil fertility and the amount of fertilizers applied to the trees. Comparison of the present results with the previous studies is quite complicated due to varietal differences and diverse ecological conditions.

The results showed that the date palm (Mashkeel variety) grown in Pakistan could be a good source of nutritionally important constituents and vital mineral elements. The current work is the first of its kind, which will provide useful data as baseline for further studies. These findings may be helpful for the concerned government parties and public sector regarding the nutritional potentials of Pakistani dates.

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