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Analysis of Essential Elements of Three Different Varieties of Saudi Arabian Date Palm (*Phoenix dactylifera*)

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The elements present in seeds and leaves of three varieties of Saudi Arabian date palm (*Phoenix dactylifera*) were analyzed by inductively coupled plasma optical emission spectroscopy (ICP-OES). In general it has been found that all the three varieties contain sound but variable amount of element content. Potassium was found to be in abundance in var. Barhee and Sukri, whereas in var. Rothana calcium content was highest. Elements Ca, Mg, Fe and Mn were observed to be higher in leaves of all three varieties than respective seeds. However reverse was found true for P and Zn content. It was observed that sodium content was higher in the leaves of var. Rothana and Sukri while in var. Barhee it was higher in seeds. The micro element Cu was found to be highest in seeds of Barhee (0.008 mg/g). The essential trace element Se was found to be present in quite good amount in all the three varieties of date palm and was highest in the seeds of Rothana (0.0043 mg/g). The present study clearly indicates the immense potential of *P. dactylifera* to be utilized in development of element supplement.

Key Words: Date palm, Element content, Inductively coupled plasma optical emission spectroscopy.

INTRODUCTION

The date palm is a major fruit tree in most of Arabian Peninsula and it is considered one of the most important co mmercial crops. Dates, the fruits of date palm constitute a substantial part of the diet in the Arabian world. Presently 2000 or more different cultivars of date palm are cultivated world-wide[1]. The beneficial health and nutrition values of date palm, for human and animal consumption have been claimed for centuries[2-4]. Phytochemically, the whole plant contains carbo-hydrates, alkaloids, steroids, flavonoids, vitamins and tannins. The phenolic profile of the plant revealed the presence of mainly cinnamic acids, flavonoid glycosides and flavanols[5,6]. Four free phenolic acids and nine bound phenolic acids have been tentatively identified[7,8]. The pharmacological studies conducted on *P. dactylifera* indicate the immense potential of this plant in the treatment of conditions such as diarrhea, gastric ulcer, skin disorders, cardiovascular disorder and inflammatory ailments including liver and kidney disorders, microbial and viral infections, cancer. Date palm is considered as a potentially safe and effective plant that has important medicinal values and benefits[9].

Plant derived drugs are gaining importance due to their minimal side effects, easy availability and acceptability. Furthermore plant parts are used raw to overcome macro and micro nutrient malnutrition[10]. Most studies on such medicinal plants pertain to their organic contents, *viz.*, essential oils, glycosides, vitamins, alkaloids and other active components and their pharmacological/therapeutic effects. Besides several organic compounds, it is now well established that many trace elements play a vital role in general well-being as well as in the cure of diseases[11]. The leaves of the plants are still used in several countries, for their therapeutic effects. The elements associated with life process have been classified into macro nutrients, which are needed in large amount such as sodium, calcium, magnesium, potassium, chlorine *etc*. The other category is of those elements which are required in very small amounts, include vanadium, chromium, manganese, iron, cobalt, copper, zinc and molybdenum and the non-metals selenium, fluorine and iodine[11]. Since these trace elements constitute a minute fraction in different parts of the medicinal plants, a sensitive and reliable analytical technique is a prerequisite for obtaining precise and accurate data[12].

Most of the available literature on element content of date palm deals with fruits rather than vegetative parts such as leaves, though some studies were carried out on role of elements in growth and development of plant[13,14]. The numbers of date palm in the Kingdom of Saudi Arabia are estimated to be over 23.5 million. These trees are estimated to yield about 210,000 tons of fronds. Every year about three million palm trees are pruned and the portion becomes a waste[15]. Thus, the study was planned to find out the possible use of date palm

leaves as a source of element/mineral supplement. The elements of date palm leaves were determined by inductively coupled plasma-optical emission spectroscopy (ICP-OES).

EXPERIMENTAL

Collection and storage of date palm leaves: Fresh leaves and dates of three varieties of date palm, Barhee, Sukri and Rothana were kindly provided by Mr. Abdulmohssin Al-Shamlan from his Al-Shamlan date farm (Onaizah, Al-Qassim). Samples were labeled and stored at 4ºC in polythene bags till they were processed.

Sample preparation: Surface contaminants of the leaf samples were removed by washing twice with deionized water and then with deionized double distilled water. The leaves were air dried in a clean drying chamber for 15 days. Whereas seeds/pits were manually removed from the fruits and samples were washed with distilled water and were dried at 40 ºC for 2 days in an oven (Memmert, Germany). The dried leaves and seeds/pits samples were separately ground well into a fine powder with the help of mill (IKA werke, GMBH & Co., Germany). The powder was stored in air sealed plastic containers at room temperature until analyzed.

Digestion and analysis of sample: Powdered leaves and seeds/pits samples (0.5 g) were separately digested with conc. sulphuric acid (3.5 mL) and 30 % hydrogen peroxide (3.5 mL) by heating at 25 ºC for 0.5 h. After cooling, 30 % hydrogen peroxide (1 mL) was added and filtered to get the clear solution. The filtrate was diluted to 20 mL with deionized distilled water[16]. The digested samples were analyzed to determine the content of calcium, magnesium, phosphorus, potassium, iron, copper, zinc, manganese, sodium and selenium by inductively coupled plasma optical emission spectroscopy, Perkin-Elmer Optima 4300 DV ICP-OES.

RESULTS AND DISCUSSION

The results of the analysis of essential element content of leaves and seeds/pits of three varieties of Saudi Arabian date palm showed the presence of Ca, Mg, P, K, Na, Cu, Zn, Mn and Se (Table-1). It was observed that potassium was the most abundant element in the leaves and seed/pits of var. Barhee and Sukrim whereas Ca was found in relatively high concentration in var. Rothana. The other elements were found in various proportions in the leaves and seeds/pits of three varieties of date palm. It has been observed that the sodium content was higher in the leaves of Rothana and Sukri (0.1059 and 0.1396 mg/g, respectively) while in var. Barhee it was higher in seeds (7.8146 mg/g).

Calcium contents was highest in the leaves and seeds/pits var. of Barhee (5.268 and 0.3396 mg/g, respectively). Phosphorus and zinc were relatively high in seeds/pits of var. Rothana (1.360 and 0.0214 mg/g, respectively) while the level of magnesium was highest in leaves of var. Rothana (2.214 mg/g). Leaves of all three varieties of *P. dactylifera* contain significant amount of iron and it was highest in leaves of var. Barhee (0.2183 mg/g). These varieties of date palm also have different amount of Mn, Cu and Se. Manganese was higher in the leaves than seeds in all three varieties and it was same in leaves of var. Rothana and Barhee (0.0132 mg/g). The micro element Cu was found to be highest in seeds of Barhee (0.008 mg/g). The essential trace element Se was found to be present in quite good amount in all three varieties of date palm and was highest in the seeds of Rothana (0.0043 mg/g).

The ratio of K/Na in three varieties of date palm is presented in Fig. 1. It was observed that K/Na ratio was higher in leaves of var. Barhee and Sukri, whereas in var. Rothana the K/Na ratio was higher in seeds. However the Fe/Zn ratio was higher in leaves of all date palm than seeds (Fig. 2).

The results revealed that the date palm leaves and seeds/pits, depending upon the variety contain significant but quite variable amounts of essential elements. Our results are in agreement with a study of Kahtani *et al*.[17] they determined the leaf mineral composition of seventeen date palm cultivars and found a significant variation in mineral content between the cultivars and growth stages. Similarly, Gassim *et al*.[18] analyzed the leaf mineral composition (N, K, P, Ca, Mg, Na, Fe, Mn, Zn and Cu) of four date cultivars *i.e.*, Khalas, Ruzeiz, Shieshi and Hatami. They observed that cultivars varied significantly with respect to mineral content. In a study the mineral ion composition of six different cultivars of Bahraini date palm seeds (Khalas, Murzban, Khunaizi, Khawajah, Khasaib Asfor and Khaseeb) were analyzed using flame atomic absorption spectroscopy (AA and ICPS). The essential bulk metal ions in the six cultivars were found to be dominant, where K^+ was the highest and Ca^{2+} was the lowest[13].

TABLE-1
ELEMENTS CONTENT IN THE SEEDS AND LEAVES OF *P. dactylifera* VAR. ROTHANA, BARHEE AND SUKRI

Elements	Varieties					
	Rothana		Barhee		Sukri	
	Seed	Leaves	Seed	Leaves	Seed	Leaves
	mg/g		mg/g		mg/g	
Calcium	0.2228 ± 0.00057*	4.092 ± 0.00061	0.3396 ± 0.0004	5.268 ± 0.0005	0.1501 ± 0.0001	4.822 ± 0.00051
Magnesium	0.9259 ± 0.0009	2.214 ± 0.0005	0.8773 ± 0.0003	2.010 ± 0.00058	0.7350 ± 0.0002	2.190 ± 0.0005
Sodium	0.0897 ± 0.00041	0.1059 ± 0.00028	0.1569 ± 0.00016	0.1226 ± 0.00023	0.07375 ± 0.0001	0.1396 ± 0.00015
Potassium	2.8343 ± 0.00115	2.068 ± 0.00048	2.699 ± 0.00003	7.8146 ± 0.00079	4.0047 ± 0.00063	7.885 ± 0.0006
Phosphorus	1.360 ± 0.0010	1.015 ± 0.00055	1.222 ± 0.0005	0.9375 ± 0.00025	1.1825 ± 0.0005	0.8550 ± 0.0005
Iron	0.0225 ± 0.0005	0.1422 ± 0.00015	0.0549 ± 0.0001	0.2183 ± 0.00036	0.0212 ± 0.0002	0.1106 ± 0.0002
Zinc	0.0214 ± 0.0004	0.013 ± 0.00006	0.0211 ± 0.00025	0.0150 ± 0.00012	0.0195 ± 0.0001	0.0131 ± 0.0001
Copper	0.0077 ± 0.0002	0.0069 ± 0.00006	0.008 ± 0.0001	0.0061 ± 0.00021	0.064 ± 0.0001	0.0070 ± 0.00006
Manganese	0.0082 ± 0.0002	0.0132 ± 0.00015	0.0062 ± 0.0002	0.0132 ± 0.0001	0.0058 ± 0.0001	0.0108 ± 0.0001
Selenium	0.0043 ± 0.0003	0.0035 ± 0.00006	0.0004 ± 0.0	0.0027 ± 0.00006	0.0005 ± 0.0	0.0037 ± 0.0002

*Values represent the mean ± SD of three replicates.

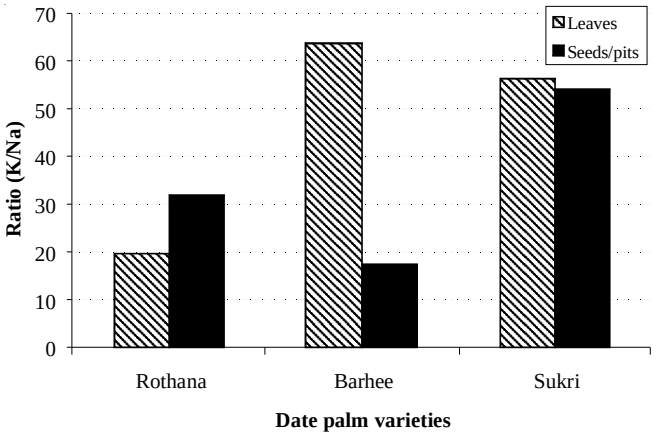

Fig. 1. K/Na ratio of leaves and seeds/pits of *P. dactylifera* var. Rothana, Barhee and Sukri

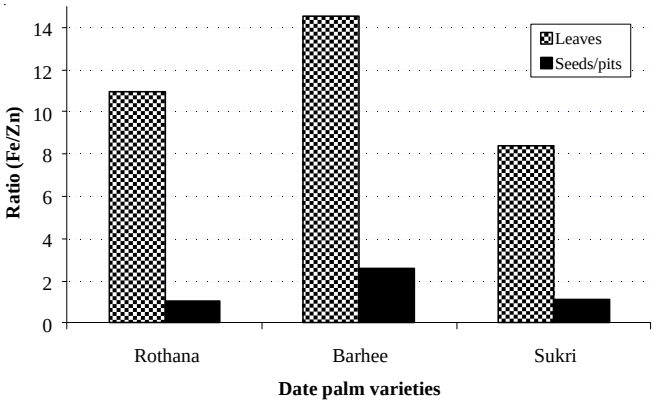

Fig. 2. Fe/Zn ratio of leaves and seeds/pits of *P. dactylifera* var. Rothana, Barhee and Sukri

It has been found that calcium content was highest in the leaves and seeds/pits var. of Barhee. In plants, calcium is taken up in the ionized form (as Ca^{2+}); the leafy parts are relatively high in calcium and low in phosphorus, whereas, the reverse is true of the seeds[19]. The higher Ca content in the leaves and seeds/pits of Barhee suggests its possible use to overcome deficiency of Ca. The recommended daily dietary allowance of Ca for children is between 500, 1000 and 800 mg for adults[20]. As the leaves and seeds/pits of the date palm contains good amount of iron it can be utilize in the preparation of iron rich supplements to compensate iron deficiency. These varieties of date palm also have different amount of Mn, Cu and Se. Metals manganese, iron, copper and zinc and the non metal selenium are essential trace elements for all forms of life. In humans Mn, Fe, Cu, Zn and Se accomplish decisive functions to maintain human health. Deficiency in any of these trace elements leads to undesirable pathological conditions that can be prevented or reversed by adequate supplementation[11].

In this study, the positive correlation was observed between Na and K as well as Fe and Zn concentrations in different varieties of date palm. Thereby it indicates the inter-connected physiological mechanisms for their uptake/translocation in the leaves. This is in the line of previous report which has suggested interrelationship of essential elements like K, Na, Fe and Zn[12]. The relationship between elemental content and curative capability is yet to be established; however such studies are important for understanding the pharmacological action of medicinal plants. The data obtained in the present study will be helpful in understanding the role of element content in categorizing the varieties of *P. dactylifera* as well as in the development of supplements.

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