

Full Length Research Paper

Proximate composition and mineral profile of eight different unstudied date (*Phoenix dactylifera* L.) varieties from Pakistan

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With the aim of extending the knowledge on chemical composition of dates (*Phoenix dactylifera* L.), eight different sun dried date varieties; (1) Daki, (2) Aseel, (3) Coconut, (4) Khuzravi, (5) Halavi, (6) Zahidi, (7) Deglet Noor and (8) Barkavi were examined to determine their proximate composition and mineral profile. All the date varieties were found to be rich in proteins, fiber, carbohydrates and net gross energy (352.329 Kcal/100 g in Aseel to 425.147 Kcal/100 g in Khuzravi) having suitable levels of lipids and low values of ash, moisture and oxalates. Na, K and Li were found as macrominerals where as Cr, Cu, Ca, Mg, Ni, Zn and Mn were found as microminerals. The results suggest that all the studied dates serve as good source of vital nutrients and can be considered as premium quality having significantly higher energy values than the earlier reported values for dates.

Key words: Date, minerals, proteins, energy, oxalates.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the earliest cultivated tree crop (Wrigley, 1995). Palm trees are abundant all over the world, particularly in the Arab Gulf area. It is considered to be the most important tree in most of the Arabian countries (Mustafa et al., 1983). In the United Arab Emirates, it is estimated that there are over ten millions of fruitful palm trees. In the oases of Morocco, date palm constitutes the main income-generating activity. Among date producing countries Pakistan comes at sixth place and there are more than 325 varieties of dates available in Pakistan.

The date palm is a delicious perennial monocotyledon with long generation time (a period of 4 to 5 years is necessary to reach the first flowering) and continues fruit production with an average age yield of 400-600 kg/tree/year for up to 60 years (Shinwari, 1993). The fruits are arranged on spikelets bearing 20-60 individual dates and

for the formation of bunch (5-30 bunches per tree) a number of such spikelets are attached to a central stalk. Traditionally, dates are propagated from of shoots produced by elite individual trees. Now dates are also clonally propagated. In Morocco, more than 220 varieties, clonally propagated, have been enumerated (Toutain et al., 1971). Another interesting property about dates is that all commercial varieties are exclusively female and yet there is no method of producing male palms of these varieties.

Currently, several human health problems are related to diets. Micronutrients are involved in numerous biochemical processes and an adequate intake of certain micronutrients is necessary for the prevention of deficiency diseases. Malnutrition is of major concern for many developing countries of world (Özcan, 2004; Leterme et al., 2006; Kumari et al., 2004).

The fruit of the date palms are consumed throughout the world and are an important part of the diet in the Middle East. Dates are being consumed in modern cultures for their pleasant flavor, odor and their biting texture in addition to their use for flavoring foods, beverages and medication (Vayalil, 2002). Minerals are critical for enzyme activation, gene expression, bone formation, hemoglobin composition and

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Figure 1. Date varieties evaluated (a) Khuzravi, (b) Zahidi, (c) Deglet Noor, (d) Daki, (e) Aseel, (f) Halavi, (g) Coconut, and (h) Barkavi.

amino acid, lipid along with carbohydrate metabolism. Minerals are also required for normal cellular functions (Institute of Medicine (IOM), 2000b, 2001, 2004). Certain inorganic mineral elements (K, Zn, Ca and traces of Cr etc.) play an important role in the maintenance of normal glucose tolerance and in the release of insulin from beta islets of Langerhans (Choudhary and Bandyopadhyay, 1999). The reports on mineral composition of dates are based on non representative samples or old methodology. The mineral compositions of fruit reflect the trace mineral contents of soils in any geographic region.

The objective of the present study was to report the nutritional data of some of the unstudied date varieties in addition to providing current information for tropical fruit growers.

MATERIALS AND METHODS

Dates were obtained from a super market in Faisalabad, Pakistan. Specimen identification (Figure 1) was done by Pmalogy Section, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan. The date samples were packed in opaque plastic bags. The collected dates were sun dried to constant weight and were stored in airtight jars for further studies.

All chemicals used during the present study were of the analytical reagent grade. The pure cellulose, moisture content, ash content, crude protein, crude lipids and total carbohydrates of dates were determined using standard methods described by Association of Official Analytical Chemists (AOAC, 2000). The energy values of dates were evaluated using formula described by Crisan and

Sands, (1978).

Energy value (Kcal/100g = (2.62 × % protein) + (8.37 × % fat) + (4.2 × % carbohydrate)

The date samples were wet digested according to the method described by Sivrikaya et al. (2002). The Na, K and Li were analyzed using flame photometer (Sheerwood 450 flame photometer) (Horwitz, 1980). The trace metals (Cr, Cu, Pb, Zn, Mn, Ni, Ca, and Mg) concentration was determined by methods described by Barminas et al. (1999) and Kaneez et al. (2001) using Perkin Elmer AAnalyst 300 spectrometer.

All experiments were performed in triplicate and results were presented in mean value ± SD. All statistical analysis was performed using statistical functions of Microsoft Excel, 2004.

RESULTS

The references on the chemical composition and nutritional value of dates are currently scarce or extremely discrepant, because of the genetic origin of isolates, methodologies of cultivation, and environmental factors like climate, temperature etc. Proximate analysis was carried out on eight different date varieties: Daki, Aseel, Coconut, Khuzravi, Halavi, Zahidi, Deglet Noor and Barkavi. Results of proximate composition and gross energy values of dates are presented in Table 1.

Protein contents were generally high and varied between $32.5 \pm 1.52\%$ in Zahidi to $42.5 \pm 2.25\%$ in Deglet Noor. Carbohydrates appear to be abundant in all tested

Table 1. Proximate composition of dates (*Phoenix dactylifera*).

Parameters	Aseel	Daki	Coconut	Khuzravi	Halavi	Deglet Noor	Barkavi	Zahidi
Moisture (%)	7.2±0.34	5.0±0.25	7.2±0.34	1.6±0.08	0.84±0.01	7.4±0.37	9±0.45	9.8±0.49
Ash (%)	2.19±0.05	2.33±0.08	2.87±0.1	2.39±0.09	2.07±0.04	1.82±0.03	2.18±0.06	2.24±0.06
Crude protein(%)	41.25±2.05	40.62±1.74	36.25±1.84	37.50±1.86	38.75±1.78	42.5±1.74	34.87±1.74	32.5±1.52
Crude lipid (%)	9.05±0.42	14.44±0.62	24.08±1.24	16.42±0.67	14.82±0.64	10.12±0.52	11.24±0.55	9.52±0.49
Carbohydrate (%)	40.22±2.01	37.79±1.78	45.11±2.25	43.58±2.14	29.62±1.47	40.95±2.05	42.71±2.13	45.94±2.25
Total oxalate (g/100 ml)	0.538±0.043	0.192±0.021	0.504±0.048	0.481±0.04	1.128±0.042	0.432±0.038	0.528±0.047	0.36±0.039
Crude fiber (%)	86.08±3.95	62.11±2.96	70.12±2.98	81.25±3.22	66.58±2.91	64.12±2.84	68.34±2.94	85.57±3.35
Energy value (Kcal/100 g)	352.329	386.005	420.845	425.147	408.604	368.044	364.820	357.780

date samples. Total carbohydrate content (calculated by difference) of Khuzravi was highest ($45.11 \pm 2.15\%$) while in other date varieties it ranged from $29.6 \pm 1.47\%$ in Halavi to $37.79 \pm 1.78\%$ in Daki. The lowest crude fiber content was in Deglet noor ($64.12 \pm 3.23\%$), and the highest was in Aseel ($86.08 \pm 4.32\%$). With respect to fat contents Coconut had the highest ($24.08 \pm 1.24\%$) value and Aseel had the least ($9.05 \pm 0.42\%$). Khuzravi had the highest value of gross energy (425.147 Kcal/10 g) followed by Coconut (420.845 Kcal/100 g), Halavi (408.604 Kcal/ 100 g), Daki (386.005 Kcal/100 g), Deglet Noor (368.044 Kcal/100 g), Barkavi (364.820 Kcal/100 g), Zahidi (357.780 Kcal/100 g), while Aseel had the least (352.329 Kcal/100 g). Moisture contents of different date varieties ranged from 0.84 ± 0.01 in Halavi to $9.82 \pm 0.47\%$ in Zahidi. Ash contents varied between 1.82 ± 0.13 in Deglet Noor to $2.87 \pm 0.23\%$ in Coconut. Oxalate contents varied between 0.192 ± 0.005 g/100 ml in Daki to 1.128 ± 0.02 g/100 ml in Halavi.

There was a wide variation in the contents of lithium, starting from 2.185 ± 0.24 mg/g in Deglet Noor to high levels of 6.270 ± 0.31 mg/g in Zahidi. Potassium contents ranged from 5.820 ± 0.291 mg/g to 8.880 ± 0.352 mg/g in Aseel on dry weight

basis in these eight varieties of dates and was highest among detected eleven mineral elements as indicated in Figure 2. Among eight date varieties, zinc was detected in only six; Aseel, Barkavi, Khuzravi, Halavi, Coconut and Zahidi. The highest level of zinc was measured in coconut 0.966 ± 0.001 mg/g as shown in Figure 3. Aseel had a highest content of sodium 3.135 ± 0.15 mg/g, whilst the rest fell in the range of 1.712 ± 0.20 mg/g (Khuzravi) to 2.755 ± 0.26 mg/g (Zahidi). Magnesium concentration levels were highest in Aseel 0.2704 ± 0.001 mg/g followed by Zahidi 0.207 ± 0.001 mg/g, whereas Daki had the lowest concentration level 0.2064 ± 0.003 mg/g. Of the eight varieties analyzed, minimum and maximum values of calcium were 0.2512 ± 0.01 mg/g in Burkavi to 0.8495 ± 0.01 mg/g in Halavi as indicated by Figure 4. Manganese concentration ranged from 0.02 ± 0.001 mg/g in Aseel to 1.823 ± 0.001 mg/g in Zahidi. The concentration of copper was high in Coconut 0.7274 ± 0.01 mg/g compared to other date varieties having concentrations ranging from 0.012 ± 0.01 mg/g in Deglet Noor to 0.3112 ± 0.01 (mg/g) in Aseel as shown in Figure 5. Chromium and nickel were present in very low concentration in all the varieties. Chromium ranged from 0.0182 ± 0.01 mg/g in Daki to 0.5865

± 0.01 mg/g in Coconut and nickel contents ranged from 0.033 ± 0.002 mg/g in Halavi to 0.0736 ± 0.001 mg/g in Aseel. Lead was not detected which indicates that this toxic metal is not present in detectable amount in all samples.

DISCUSSION

In human diet protein quality and quantity are of major concerns. WHO/FAO suggests a daily intake of 0.88 g of protein per kg body weight for children in the age range of 1-10 years. The crude protein contents of dates is higher than that recorded for protein rich foods including cowpea seeds (24.7%), lentil (26.1%), *Mucuna flagellipes* (24.9%), greenpea (24.9%), *Tamarindus indica* and *Parkia biblobosa* (20.9%) (Iqbal et al., 2006). It is, however, comparable with values obtained for soya beans (35%) (Amoo et al., 2006). Consumption of 100 g of these date varieties may be capable of providing 32.5-42.5 g of protein which satisfies recommended daily allowance of protein for children's as well as adults.

Carbohydrates provide the necessary calories in the diets of most people of the world. Carbohydrates are easily digested and promote the utiliza-

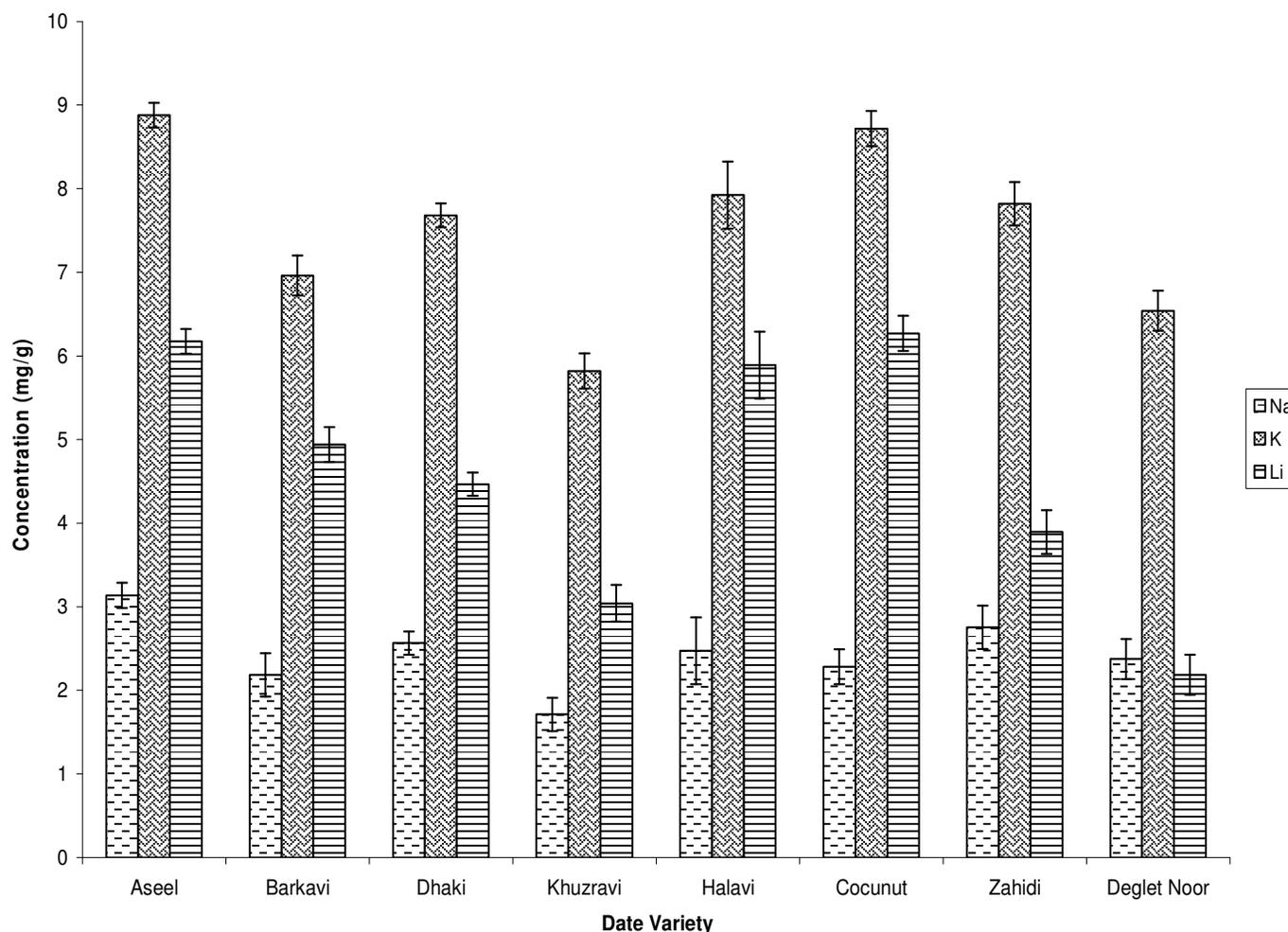


Figure 2. Amounts of sodium, lithium and potassium in the different date varieties.

tion of dietary fats and reduce wastage of protein (Christian and Ukhun, 2006). The carbohydrate values obtained for different date varieties are comparable with the values given by Sumati and Rajagopal (1989) for peas, mangoes, potatoes and etc. The importance of fiber in diet cannot be neglected because it decreases serum cholesterol levels, risk of coronary heart diseases, hypertension, diabetes, colon and breast cancer (Ishida et al., 2000). A high value of carbohydrates and crude fiber make dates a really useful fruit for consumers.

Fat is an important energy source of body. Fat is one of the three nutrients (along with proteins and carbohydrates) that supply calories to the body. Fat provide 9 calories per gram, more than twice the number provided by carbohydrates and proteins. Fats play many vital roles in human body. Fats are required for brain structure and are necessary for the production of hormones to regulate and initiate body activities. Fat is essential for the proper functioning of body. They provide the "essential" fatty acids which are not made by the body and must be obtained from food. The sense of satiety experienced

after eating dates might be attributed to its high caloric value computed from its protein, fat and carbohydrate contents (Crisan and Sands, 1978). Due to high values for fats and gross energy this food promises a good nutritive supplementary source for human beings.

The determination of plant material's moisture contents is important because many of the physical properties of foods are known to vary with moisture content. Low value of moisture contents showed that these dates can be stored for a long period of time without spoilage and it will not be susceptible to microbial growth (Oloyede, 2005). Low ash contents in dates indicate that the total inorganic mineral is low (Oloyede, 2005). Oxalates are harmful for human beings as they can complex with most essential trace metals therefore making them unavailable for enzymatic activities and other metabolic processes (Ekop, 2007). Low values of oxalate contents in all the date varieties enhance the edibility of these food materials which would be advantageous for the consumers. All the values of studied parameters are presented below (Table 1).

Lithium is an element with beneficial pharmacological

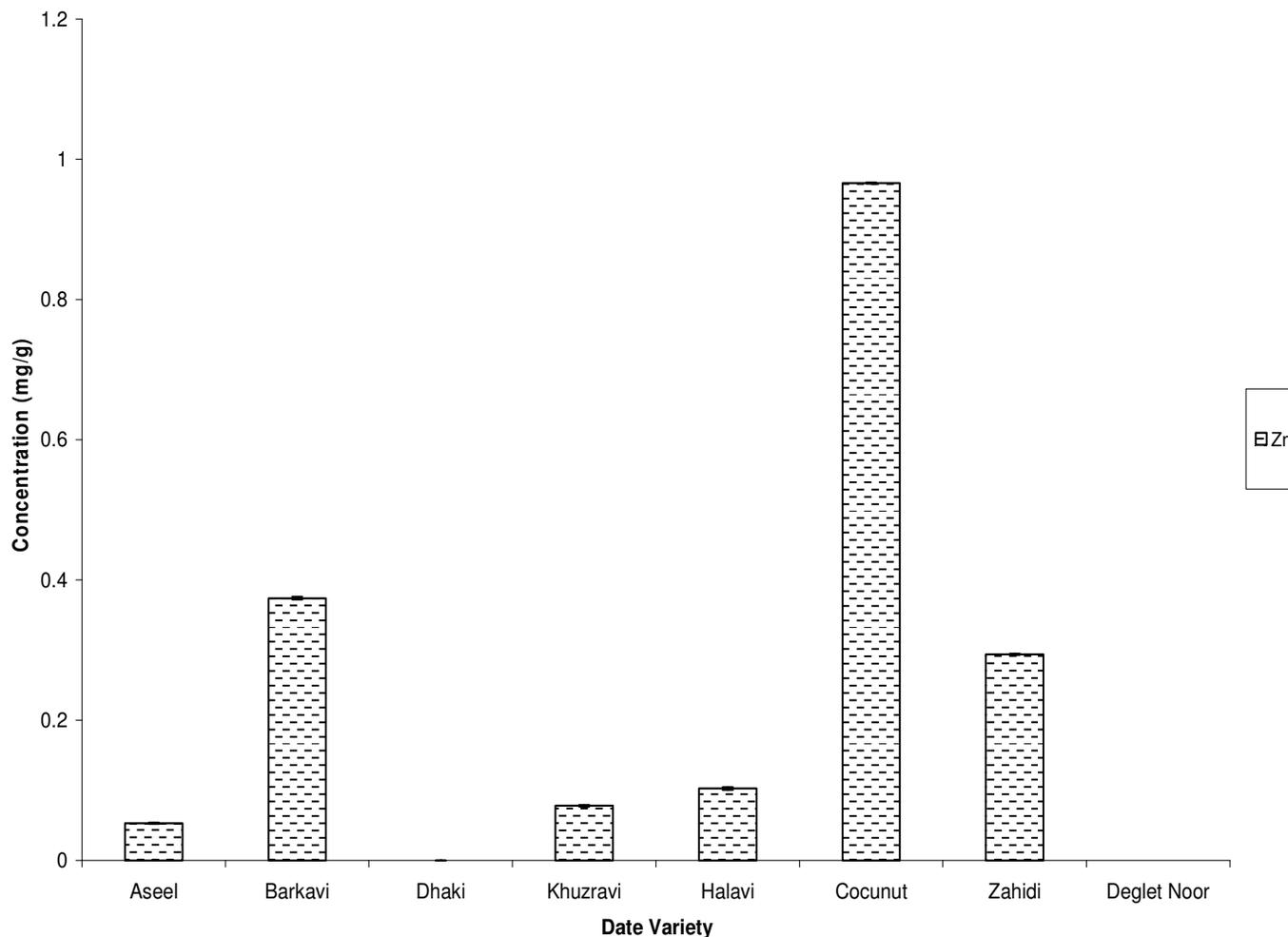


Figure 3. Amount of zinc in different date varieties.

properties. It has been used effectively in the treatment of many depressive disorders (Marakoğlu et al., 2005). Potassium is vital to cellular integrity and fluid balance as it plays an important role in nerve function. It also helps to metabolize proteins and carbohydrates in energy production, and regulates heart beat (Ozcan, 2004). These sun dried dates can supply approximately 9% of the dietary reference intakes (DRI) for potassium. Zn plays a vital role in cellular membrane structure and function, and helps to maintain adequate levels of vitamin A in the body. It acts as a potent antioxidant and is essential for growth and development of healthy body tissues, proper immune function and regulation of insulin. Distorted enzymatic activity and poor electrolyte balance of the blood fluid are related to inadequate K, Mg, Zn and Na as they are the most required elements of living cells (Ekop, 2007). New DRI values for potassium, magnesium, zinc and sodium have been established. Nutritionally these minerals have great importance in dates. The DRI value for potassium is 4700 mg/day. The DRI values of magnesium, zinc and sodium for males and females as

recommended by the Food and Nutrition Board of the Institute of Medicine (IOM) are 320 and 420 mg/day, and 8 and 11 mg/day and 1500 mg/day. All the date varieties can supply suitable levels of these minerals (IOM, 2004).

Calcium is the most abundant mineral in the body. Calcium regulates many cellular processes and has important structural role in living organisms. Skeletal muscle structure and function, polymerization of fibrin and conduction of impulses in the nervous system are regulated by calcium (Tandoğan and Uluşu, 2005). The DRI value for calcium is 1000 mg/day (IOM, 2004). Manganese is essential for proper brain function also it metabolizes proteins and carbohydrates. Manganese is required for cholesterol and fatty acid formation as well as collagen formation (Letereme et al., 2006). The DRI values of manganese for females and males are 1.8 and 2.3 mg/day respectively. Daily consumption of dates could easily satisfy the DRI values for manganese. Copper is a multi-talented mineral which sustains life. Copper is vital to the health of the body right from fetal development to the old age. Without copper human nervous

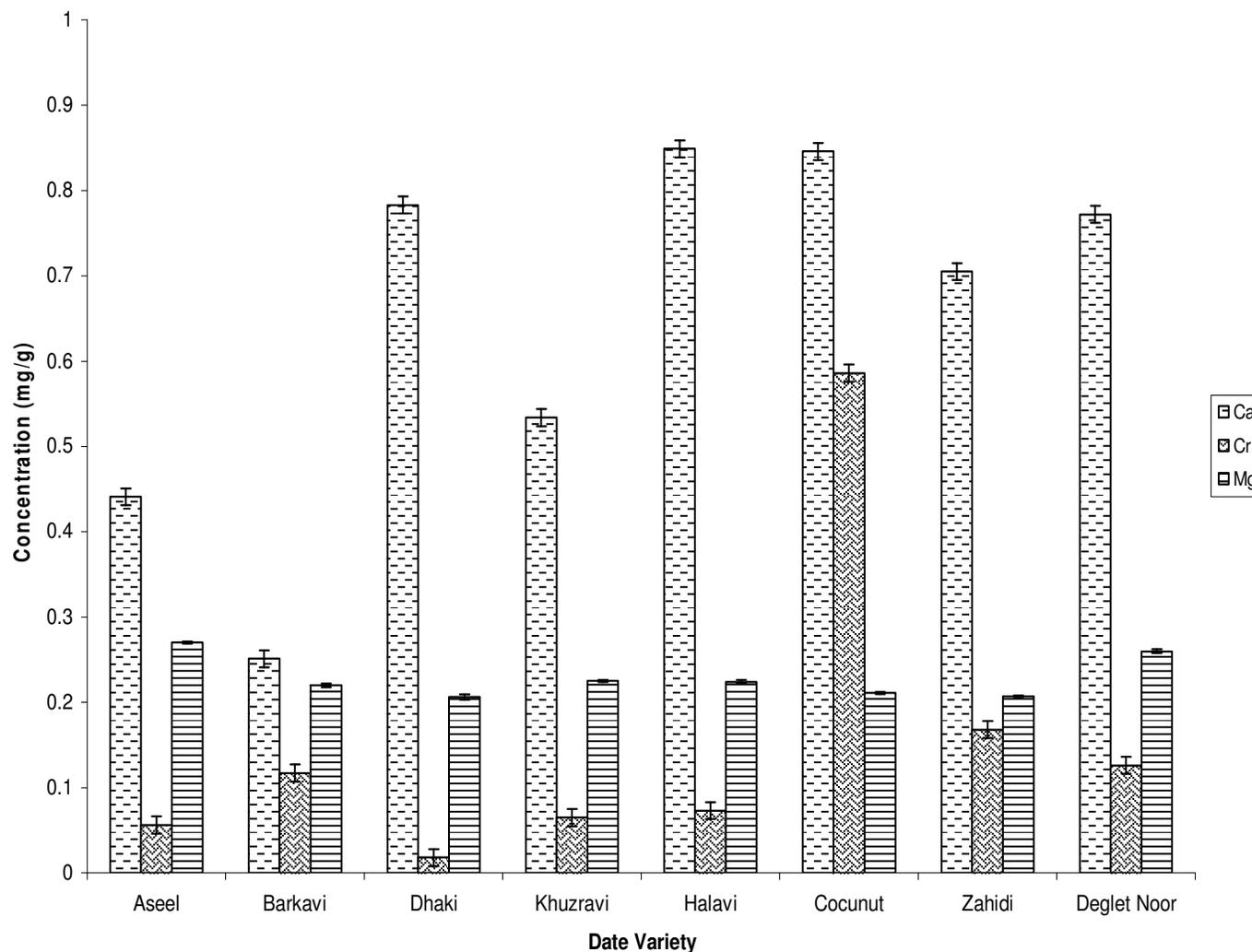


Figure 4. Amounts of calcium, chromium and magnesium in different date varieties.

system and cardiovascular system could not function normally. Moreover it accelerates wound healing by increasing blood flow to the affected area and moves oxygen around the body too (WHO, 1998). The recommended DRI values for copper are 0.9 mg/day (IOM, 2004).

Chromium is a trace mineral important in health and nutrition; it works with insulin to help regulate and maintain normal blood glucose levels. Chromium can be found naturally in foods and also comes in a variety of supplemental forms. The estimated requirement for chromium in humans is about 1 µg/day. It also plays an important role in glucose and fat metabolism (Mutuma et al., 1999). Nickel numbers among the essential elements. Human body contains about 10 mg and a daily intake of 100 µg of nickel is recommended. The concentration of manganese, nickel and copper for all these date varieties is shown in Figure 3. The absence of lead in all the samples could be of great advantage to the consumers since lead

has been reported to be highly toxic even at low concentrations (Asaolu et al., 1997). All these date varieties can supply suitable level of these minerals as compared to the values recommended by IOM showing their nutritional importance.

From the results of the present study, the following conclusions can be drawn for the eight studied date varieties in human diet. First, dates are an ideal high-energy food, rich in carbohydrates, dietary fiber and minerals such as calcium, magnesium, manganese, copper, nickel, chromium, potassium and zinc.

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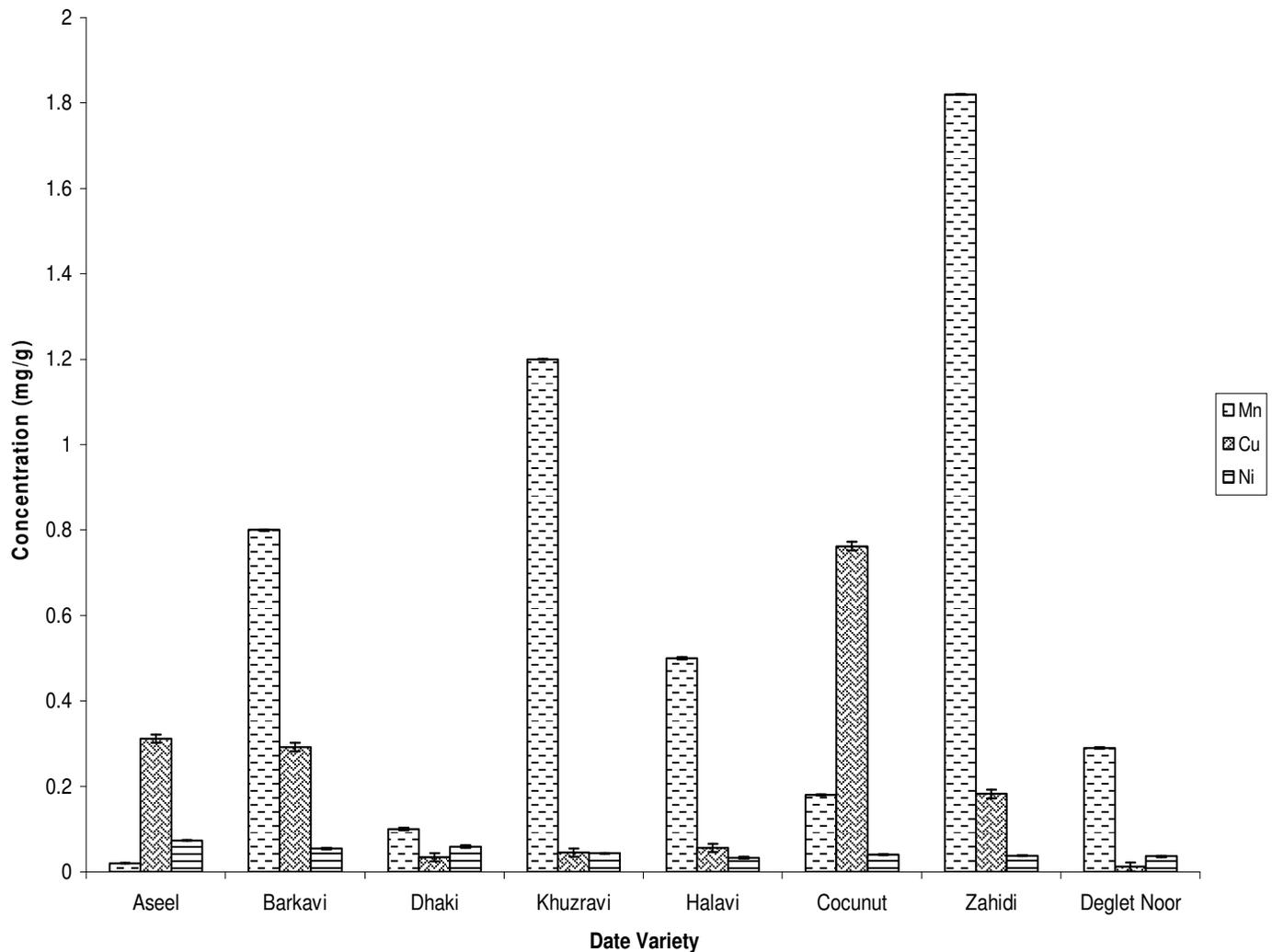


Figure 5. Amunts of manganese, copper and nickel in different date varieties.

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