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Would Aluminum and Nickel Content of Apricot Pose Health Risk to Human?

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Abstract

Higher demands of food production for human consumption increased uses of fertilizers and other chemicals that arise in a major public problem and heavy-metal pollution. Levels of Aluminum and Nickel which affect mankind health in exact doses, were determined in fresh and dried samples of 'Jumbo Cot', 'Tom Cot', 'Gold Strike', 'Gold Bar', Bergeron', 'Bergarouge', 'Sweet Cot', 'Yellow cot' and 'Zebra' apricot cultivars to assess possible health risk of apricot (*Prunus armeniaca* L.) consumption. Highest content of Al and Ni among all cultivars, where 9.71 and 2.14 mg/kg of dehydrated apricot samples. Fresh fruit samples maximally contain 2.9 and 0.425 mg/kg of Aluminum and Nickel respectively. Data analysis showed significant differences between cultivars for Al and Ni. Furthermore, to reveal the health-risk possibility of dried and fresh fruit consumption daily intake of elements and health-risk index were calculated and compared.

Keywords: chemical composition, heavy metals, health risk index; *Prunus armeniaca* L.

Introduction

The metal contents of food are gaining importance because of toxicological as well as their nutritional viewpoints. Dietary intake is considered to be the major supplier of these elements for the body (Demirozu *et al.*, 2002). Heavy metals normally occurring in nature are not harmful, because they are only present in very small amounts. However, if the levels of these metals are elevated, then they can show negative effects (Tuzen, 2007). Aluminum is a non-essential metal that would be toxic even in trace amounts (Gogoasa *et al.*, 2005). Human exposure to heavy metals can occur through a variety of routes, such as inhalation of air pollutants or contaminated soil particles and consumption of contaminated foods (Bordajandi *et al.*, 2004). Heavy metals contamination of orange fruits by Rossini *et al.* (2003), plantain by Selema and Farago (1996), mango and almond by Ademoroti (1986), lemon, sweet orange and grapefruits by Gorinstein *et al.* (2001), chiku, papaya, mango, muskmelon and apple by Parveen *et al.* (2003), quince and grape by Pinochet *et al.* (1999), strawberry by Ward and Savage (1994), banana, pineapple and papaya by Santos *et al.* (2004) mango and almond fruits by Ademoroti (1986) and Li *et al.* (2006), date palm by Williams *et al.* (2005) and apricot by Saracoglu *et al.* (2009) were studied.

Apricots like other fruits constitute a rich source of vitamins and minerals (Munzuroglu *et al.*, 2003), and they are rich in β-carotenes. About 15-20% of apricots produced are consumed fresh and the rest are processed as canned, dried, frozen, jam, juice, and puree (Hui, 2006). Dried apricots are a concentrated source of fiber and one of the highly nutrient-dense dried fruits (Rieger, 2004).

The purpose of the present study is determining the concentration of Al and Ni in 9 apricot cultivars grown in Hungry and to estimate their contribution to the human daily intake of those elements by using daily intake of metals (DIM) and health risk index (HRI) to reveal health risk possibility of dried and fresh fruits consumption (Li, 2009).

Materials and methods

Plant material

Nine medium and late-ripening apricot cultivars, 'Jumbo Cot', 'Tom Cot', Goldstrike, Goldbar, 'Bergeron', 'Bergarouge', 'Sweet Cot', 'Yellow Cot' and 'Zebra' harvested by physiological maturity stage from Boldogkőváralja commercial orchard of Debrecen (Hungary).

Analysis method

Homogenized fresh and dried fruit's samples in three replicates were used for chemical analysis. Sample preparing to be in accordance with Hungarian standard (MSZ-08-1783-15:1985) For hot air drying a household tray-dryer (Model Hauser) was used. The stoned and nonsulfurated fruits were hot air dried for 24 hours to get dehydrated samples. Seeded; milled fruits without peeling were digested with concentrate HNO_3-H_2O_2 digester mixture. Five grams fresh fruit (2 g dehydrated fruit) was

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digested at 120°C during three hours in a Teflon digester. Digested samples diluted with distilled water to 100 cm^3. Examined elements were measured by Thermo Jarrell Ash Poly-scan 61E and Thermo Electron Corporation IRIS Intrepid II XDL Inductively coupled plasma emission spectrophotometers (ICP).

The investigated parameters

Daily Intake of Metals (DIM)

To evaluate this factor, the following equation was used.

$$DIM = C_{metal} \times C_{factor} \times D_{food\ intake} / B_{average\ weight}$$

Where, C_{metal} is heavy metals conc. in plants (mg/kg), C_{factor} is conversion factor to change fresh weight to dry weight, $D_{food\ intake}$ is daily intake of fruit, $B_{average\ weight}$ is body weight.

Health Risk Index (HRI)

By using Daily Intake of Metals (DIM) and reference oral dose the health-risk index were obtained.

HRI =DIM / R*f*D.

If the value of HRI is less than 1 then the exposed population is said to be safe (Khan, 2009).

Results and discussion

Aluminium

Although aluminium is the most widespread metal on the Earth's surface (8% of Earth's crust), nearly all foods contain small amounts of aluminum. Aluminum absorption of human beings is difficult to estimate. The degree of absorption has been estimated to be at least 0.2% (Elinder *et al*., 1994). The daily average intake estimated vary from 2 to 10 $mg.day^{-1}$ (Biego, 1998; Greger, 1985; Pennington, 1987). Some vegetable preparations (tea leaves, coffee beans, spices and herbs) and fruits contain more aluminum than foods of animal origin (Biego,1998). The possible connection between elevated tissue Al content and problems such as osteomalacia and neurodegenerative disorders has awakened interest in Al's intake via the diet (Lopez *et al.*, 2006). Data analysis showed significant differences between apricot cultivars for both fresh and dry samples (Fig. 1).

HRI and DIM calculated for Al's content of examined Hungarian apricot cultivars (Tab. 1), show that using 100 gr of dried apricots daily for a 60 kg human may not pose the exposed population by any problems, which made by Aluminium toxicity. HRI for all cultivars was less than 1, which means that they may be safe for exposed population

Nickel

Nickel ingestion in humans occurs through the consumption of plant and animal products. Vegetables such as legumes, spinach, lettuce, and nuts contain more nickel than other foods. In plants such as potatoes and corn, metals including nickel are primarily ligated to polysaccharides such as amylose and amylopectins (Ciesielski and Tomasik, 2004). The biological half-time or nickel clearance is on the order of 2-3 days (Onkelinx *et al*., 1973). Acute nickel poisoning by inhalation exposure or ingestion of nickel carbonyl or soluble nickel compounds can lead to headache, vertigo, nausea, vomiting, nephrotoxic effects, and pneumonia followed by pulmonary fibrosis. Chronic effects of nickel exposure by inhalation are reported among nickel refinery and plating workers to include rhinitis, sinusitis, nasal septum perforations, and asthma. Nickel is also hepatotoxic, and studies show that zinc can prevent nickel-induced toxicity and maintain normal levels and function of liver enzymes (Sidhu *et al*., 2004). Nickel, like other metals, can induce systemic lipid peroxidation and can deplete glutathione, most likely through oxidative stress mechanisms (Kasprzak *et al*., 2003; Valko *et al*., 2005). Nickel concentration of apricot samples in the

Tab. 1. Health Risk Index (HRI) and Daily Intake of Metals (DIM) calculated for Al's content of examined Hungarian apricot cultivars

Cultivar	Element content $mg.kg^{-1}$	DIM	HRI
'Zebra'	5.40653	0.009010883	0.128726905
'Sweet Cot'	5.484946667	0.009141578	0.130593968
'Gold Bar'	6.274963333	0.010458272	0.149403889
'Jumbo Cot'	6.794073333	0.011323456	0.161763651
'Tom Cot'	7.212873333	0.012021456	0.171735079
'Bergeron'	7.871773333	0.013119622	0.187423175
'Yellow Cot'	9.025483333	0.015042472	0.21489246
'Gold Strike'	9.184503333	0.015307506	0.218678651
'Bergarouge'	9.72733	0.016212217	0.231603095

DIM was calculated for consumption of 100 g of dry apricots. Body weight used was 60 kg. RfD doses was adapted from ATSDR, 2008

Tab. 2. Health Risk Index (HRI) and Daily Intake of Metals (DIM) calculated for Ni's content of examined Hungarian apricot cultivars

Cultivar	Element content $mg.kg^{-1}$	DIM	HRI
'Yellow Cot'	0.313046667	0.000521744	0.026087222
'Gold Bar'	0.80923	0.001348717	0.067435833
'Bergarouge'	0.83065	0.001384417	0.069220833
'Sweet Cot'	1.258183333	0.002096972	0.104848611
'Jumbo Cot'	1.62685	0.002711417	0.135570833
'Gold Strike'	1.742893333	0.002904822	0.145241111
'Bergeron'	1.78471	0.002974517	0.148725833
'Tom Cot'	2.09001	0.00348335	0.1741675
'Zebra'	2.143413333	0.003572356	0.178617778

DIM was calculated for consumption of 100 g of dry apricots. Body weight used was 60 kg. RfD doses was adapted from ATSDR, 2005 (0.02 mg/kg/day)

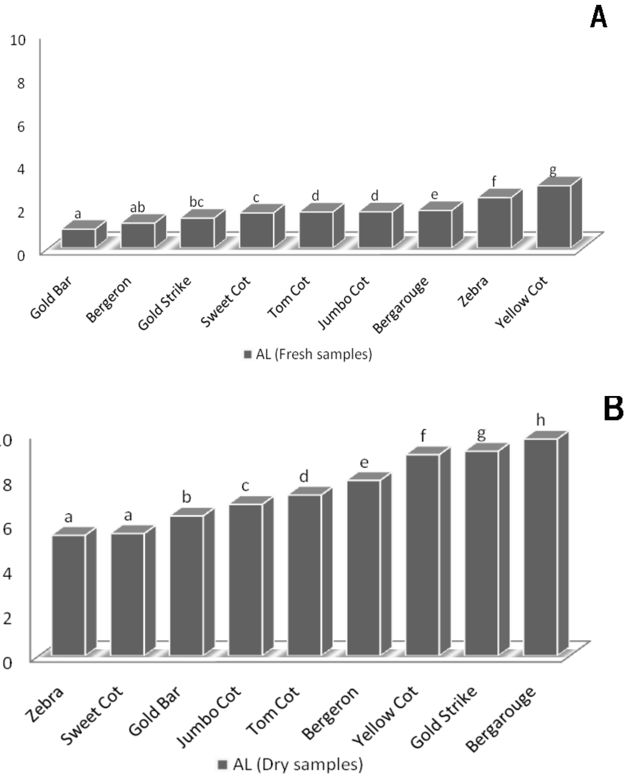

Fig. 1. Concentration of Aluminium in apricot cultivars. A: Fresh and B: Dry samples. Columns with different caption have a significant difference ($p \leq 1\%$)

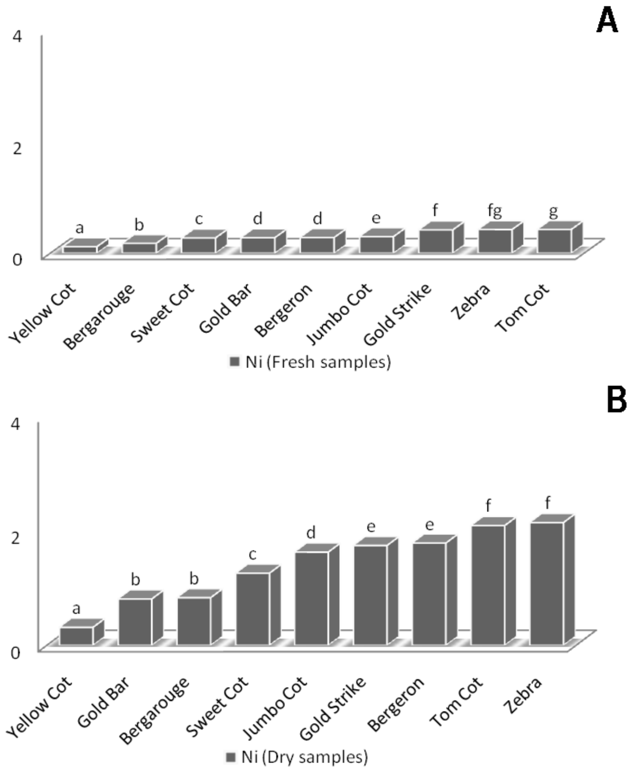

Fig. 2. Concentration of Nickel in apricot cultivars. A: Fresh and B: Dry samples. Columns with different caption have a significant difference ($p \leq 1\%$)

present study range between 0.116-2.15 mg/kg (Fig. 2). Nickel contents in the literature have been reported in the range 1.0-8.9 mg/kg in summer fruits from Pakistan (Zahoor *et al*., 2003) and in the range of 2.30-5.83 in apricots from Turkey (Saracoglu, 2009) and 1.119 mg/kg in apricots in Pakistan's market (Zahir *et al*., 2009). For Nickel, 'Yellow Cot' had the lowest and 'Zebra' had the highest concentration, 0.31 and 2.14 $mg.kg^{-1}$ respectively.

HRI and DIM calculated for Ni content of examined Hungarian apricot cultivars (Tab. 2) show that using 100 gr of dried apricots daily for a 60 kg human may not pose the exposed population by any problems, which made by Nickel toxicity. HRI for all cultivars was less than 1, which means that they may be safe for exposed population

In the same study on these cultivars for Hg, As, Pb, and Cd, calculated HRI and DIM show that using 100 gr of dried apricots daily for a 60 kg human may pose the exposed population by some problems, which made by Hg and As toxicity (Davarynejad *et al.*, 2010).

Conclusions

In regular diet, fruits have been strongly associated with reduced risk of some forms of cancer, heart disease, stroke and other chronic ailments. In conclusion, this study shows that hazardous element content of 9 examined apricot cultivars were less than the world limit and daily intake of fresh or dried apricots may not cause serious problems.

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