Bulgarian Journal of Agricultural Science, 18 (No 5) 2012, 749-751
Agricultural Academy

CONCENTRATION OF Cu AND Zn IN SOME FRUITS AND VEGETABLES GROWN IN NORTH WESTERN TURKEY

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Abstract

AYDINALP, C. and S. MARINOVA, 2012. Concentration of Cu and Zn in some fruits and vegetables grown in Northwestern Turkey. *Bulg. J. Agric. Sci*., 18: 749-751

The fruits and vegetables are the important source of essential trace elements for the people and constituted the lowest cost of main food for the majority of people in developing countries. Especially, the content of Cu and Zn in the fruits and vegetables is important for human nutrition. Cu and Zn contents were determined in twenty selected sites for each of fruits and vegetables grown in the Bursa province of northwestern Turkey. These fruits and vegetables include; apple, cucumber, grape, lettuce, onion, pepper, spinach, tomato and watermelon. The Cu concentration varied from 2.4 – 25.0 mg kg^{-1} in fruits and from 1.2 – 2.2 mg kg^{-1} in vegetables, while the Zn levels were 4.1 – 6.4 mg kg^{-1} and 5.1 – 7.6 mg kg^{-1} in fruits and vegetables respectively. The obtained Cu and Zn contents showed that fruits and vegetables from this part of the globe could serve as good dietary sources for essential trace metals, and the levels are within safety baseline content for human consumption in the province.

Key words: Cu, Zn, fruits, vegetables

Introduction

Food safety is a major public concern worldwide. During the last decades, the increasing demand for food safety has stimulated research regarding the risk associated with consumption of foodstuffs contaminated by pesticides, heavy metals and/or toxins (D'Mello, 2003). Vegetables constitute essential components of the diet, by contributing protein, vitamins, iron, calcium and other nutrients which are usually in short supply (Thompson and Kelly, 1990). Vegetables also act as buffering agents for acidic substances obtained during the digestion process. However, these plants may contain both essential and toxic elements, such as heavy metals, at a wide range of concentrations (Bahemuka and Mubofu, 1999). Metals, such as lead, chromium, cadmium and copper are cumulative poisons. These metals cause environmental hazards and are reported to be exceptionally toxic (Ellen et al., 1990).

Contamination of vegetables with heavy metal may be due to irrigation with contaminated water, the addition of fertilizers and metal-based pesticides, industrial emissions, transportation, the harvesting process, storage and/or at the point of sale. Human beings are encouraged to consume more vegetables and fruits, which are a good source of vitamins, minerals, fiber and are beneficial for health. However, these plants contain both essential and toxic metals over a wide range of concentrations. It is well known that plants take up metals by absorbing them from contaminated soil as well as from deposits on parts of the plants exposed to the air from polluted environments (Khairiah et al., 2004; Chojnacka et al., 2005).

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Therefore, Iyengar (1989) stated that knowledge of heavy metal contents in crops is important for the identification of adequate, subadequate and marginal intake levels for humans and animals, so that diseases related to trace element deficiency can be overcome. Large numbers of symptoms/ailments comprising anemia, depressed growth, dermatitis, dwarfism, electrolyte-imbalance, gastro-intestinal and neurological disorders, lethargy and nausea have been associated in humans with Cu and Zn deficiency, as well as with toxicity due to excessive intake (Somer, 1974; Graham and Cordano, 1976; Prasad, 1976; Ward, 1995).

The aim of this research was to determine the Cu and Zn contents of some fruits and vegetables commonly grown in the Bursa province of northwestern Turkey. This research also aimed at providing a baseline data on Cu and Zn levels in some fruits and vegetables for this province.

Materials and Method

The twenty sampling sites were selected for each fruit and vegetable samples from the Bursa province, Turkey. The all-sampling fields were irrigated with aquifers in the region. The pretreatment of the samples was done by crushing with a porcelain mortar and pestle or by blending to give a homogenized paste.

20 ml HNO_3 was added to 10.0 g of the sample and allowed to stand for 15 min. The mixture was heated until the liquid reduced to 5 ml. After cooling, 20 ml HNO_3, 10 ml H_2SO_4 and 8 ml H_2O_2 were added and the contents were evaporated to 5 ml. After cooling, to eliminate residual acid, 10 ml deionized H_2O was added and the mixture was boiled for 10 minutes. This was repeated twice. After cooling, the digest was filtered into 25 ml volumetric flask and made up to mark with deionized H_2O. The digestion solutions were subsequently analysed for Cu and Zn using an Atomic Absorption Spectrophotometer.

Results

The mean Cu and Zn contents for the fruits and vegetables analysed are given in Tables 1 and 2.

The Cu contents varied from 2.4 to 25 mg kg^{-1}. The lowest Cu level found in watermelon (2.4 mg kg^{-1}) and the highest Cu value was in apple (25 mg kg^{-1}). The Zn contents ranged from 4.1 to 6.4 mg kg^{-1}. The lowest content was found in watermelon (4.1 mg kg^{-1}) and the highest value was in apple (6.4 mg kg^{-1}). The Zn values in fruits were higher than the Cu concentrations in this study.

The Cu values ranged from 1.2 to 2.2 mg kg^{-1}. The highest value was found in lettuce (2.2 mg kg^{-1}) and the lowest value was in onion (1.2 mg kg^{-1}). The Zn concentrations varied from 5.1 to 7.6 mg kg^{-1}. The lowest content was found in pepper (5.1 mg kg^{-1}) and the highest value was in spinach (7.6 mg kg^{-1}). The Zn values in vegetables were higher than the Cu concentrations in this study.

The obtained results for Cu concentrations in fruits of this research are higher than 0.1–2.0 ppm reported as normal range for Cu levels in fruits (Johnson, 1997), and also higher than Cu contents obtained in most of the fruits studied by Onianwa et al. (2001) in their estimation of the adult dietary intakes of Cu and Zn contents of Nigerian foods using samples purchased from market in the city of Ibadan, South western Nigeria. The differences in Cu contents may be ascribed to variation in composition and soil types.

Kabata-Pendias and Pendias (1984) stated that, although the relationship may differ according to the plant species and tissues, but plant metal contents are generally a function of the metal concentration in the soil or in the growth solution. Lettuce had the high-

Table 1
The mean copper and zinc contents (mg kg^{-1}) of some fruits

Sample	Cu	Zn
Apple	25	6.4
Grape	3.5	6.1
Watermelon	2.4	4.1
Range	2.4 – 25	4.1 – 6.4

Table 2
The mean copper and zinc contents (mg kg^{-1}) of vegetables

Sample	Cu	Zn
Lettuce	2.2	6.3
Pepper	1.7	5.1
Onion	1.2	6.0
Spinach	1.9	7.6
Tomato	2.0	6.5
Range	1.2 - 2.2	5.1 – 7.6

est Cu level for all the vegetables analyzed. This was similar to the findings of Johnson (1997) who reported the higher Cu contents range for lettuce among other vegetables in the table of Cu levels in human foods. The Cu concentrations of onion in this study are lower than 5.0 ppm reported for the same kind of vegetables by Pinochet et al., (1999) in their study of long-term impacted soil in the Valparaiso region at Chile.

Iyaka (2007) studied the Cu and Zn content of selected samples of fruits and vegetables found north central zone of Nigeria. The Cu concentrations varied from 1.7 to 3.0 mg kg^{-1} in fruit and from 1.6 to 3.1 mg kg^{-1} in vegetables, while the Zn levels were 3.8 – 6.7 mg kg^{-1} and 4.0 – 7.0 mg kg^{-1} in fruits and vegetables respectively. These values indicated that the levels are within safety baseline contents as our results obtained for human consumption.

Therefore, Mohammed et al. (2003), have reported higher Cu values than obtained in this research for cucumber, tomato and spinach in their assessment of essential and toxic elements in some kinds of vegetables found in Arabian Peninsula. The mean Zn content of 5.9 mg kg^{-1} obtained for vegetables of this study is higher than 2.1 mg kg^{-1}, documented for vegetables in composite group of Canadian foods (Johnson, 1997). Thus, on specific vegetable specimen, Hussein and Bruggeman (1997) had determined Zn content of 7.66 mg kg^{-1} in potatoes, in their analyses for Egyptian foods; a value higher than 6.7 mg kg^{-1} obtained in this study. Moreover, Mohammed et al. (2003) stated Zn contents of twice or more values than observed in this research for carrot, cucumber, tomato, lettuce and onion in their analysis of trace elements in vegetables from Al-Taif district.

Conclusion

The concentrations of Zn in fruits and vegetables were generally higher than Cu contents. The obtained results also compare favorably with the findings of the other researchers. The levels of Cu and Zn obtained do not appear to pose any serious health hazard problem of concern yet. Furthermore, this research showed that fruits and vegetables from this part of the world could serve as good dietary sources for essential trace metals, since their deficiency or toxicity in humans may result in severe health consequences.

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Received October, 2, 2011; accepted for printing June, 2, 2012.