



# Heavy Metals Residue in Cultivated Mango Samples from Iran

M. Rahimzadeh<sup>1</sup>, S. Rastegar<sup>2\*</sup>✉

1. Food Health Research Center, Faculty of Medicine, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

2. Department of Horticultural Science, College of Agriculture, University of Hormozgan, Bandar Abbas, Iran

## HIGHLIGHTS

- Heavy metal levels were significantly higher in green mango samples comparing to ripe ones.
- No significant relationship was seen between heavy metals residue and variety in genotypes of mangos.
- Low heavy metal levels found in this study showed acceptable safety of Iranian mango samples.

### Article type

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### Keywords

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### Acronyms and abbreviations

Pb=Lead  
Cr=Chromium  
Cd=Cadmium  
As=Arsenic

## ABSTRACT

**Background:** Heavy metals contaminations are recognized as the serious risk to our environment. The aim of the present study was to analyze heavy metals residue in cultivated mango samples from Iran.

**Methods:** Totally, 72 mango samples were randomly collected among six different mango genotypes cultivated in Southern Iran from June to July 2015. Lead, chromium, cadmium, and arsenic were determined using an atomic absorption spectrometer. Analysis of variance was performed with SAS 9.0. Descriptive statistics, multivariate analysis, and Duncan multiple range tests were done with a significance level of  $p < 0.05$ .

**Results:** Measurement of heavy metals in all the mango samples showed various level ranges of lead (0.008-0.05 ppm), chromium (0.01-0.1 ppm), cadmium (0.002-0.014 ppm), and arsenic (0.01-0.04 ppm). Heavy metal levels were significantly ( $p < 0.05$ ) higher in green mango samples comparing to ripe ones. However, no significant relationship ( $p > 0.05$ ) was seen between heavy metals residue and variety in genotypes of mango samples.

**Conclusion:** The average amount of heavy metals residue in mango samples found in the current study were generally below the maximum acceptable levels indicating acceptable safety of these products.

## Introduction

Fruits are suitable sources of vitamin C, carotenoids, minerals, various kinds of antioxidants, and dietary fiber; then a diet rich in fruits is defensive against degenerative and chronic diseases such as cancer and cardiovascular diseases (Wang et al., 1996).

Contamination of fruits with heavy metals can cause serious health problems and so the amount of heavy metal contamination of foods is considered as the food quality insurance. However, in the last years, the increasing request of food safety has encouraged researches about the risk related to eating of foods contaminated by

toxic compounds (Zaidi et al., 2005). Heavy metal contamination in edible plants may be related to soil nature, climate change, irrigation with contaminated water, addition of fertilizers, etc. (Sanayei et al., 2009; Voutsas et al., 1996; Yusuf et al., 2003). Heavy metals are harmful compounds even at low concentration which have non-biodegradable nature and long half-lives. Since body does not have enough mechanisms for heavy metal elimination, therefore serious damages to human and animal tissues may happen upon contamination (Sardar et al., 2013). Accumulation of heavy metals in body may

\* Corresponding author. ✉ rastegarhort@gmail.com

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cause to disrupt function in vital organs such as heart, brain, kidneys, prostate, ovary, bone, and liver; on the other hand, they displace the vital nutritional minerals from their original place (Singh et al., 2011).

In Southern Iran, mango (*Mangifera indica* L.) is generally used in different stages of fruit development; from the tiny imperfectly set fruits to the fully ripened stage. Green fruit (immature or tender) is eatable in summer which is usually consumed in dessert from Iran. The immature green fruits are also chopped up for mango pickle and used instead of tamarind in various dishes where an acid flavor is desired. Ripened fruit is red or yellow in color and is consumed as fresh fruit. Usually ripened fruit has short shelf life and loses its quality during one week. It has been stated that variety and developmental stages of mango fruit can affect on chemical characters during fruit growth (Tharanathan et al., 2006).

Previous studies in some countries showed that depending on production site, heavy metal contamination in fruits should be monitored from view point of public health (Elbagermi et al., 2012; Grembecka and Szefer, 2013; Ismail et al., 2011). To the best of the author's knowledge, no comparative analysis of heavy metals has been carried out on native mango fruit in Iran. Therefore, the aim of the present study was to analyze some heavy metals residue including, Lead (Pb), Chromium (Cr), Cadmium (Cd), and Arsenic (As) in cultivated mango samples from Iran.

## Materials and methods

Totally, 72 mango samples were randomly collected among six different mango genotypes including, Sibi, Sarshahi, Sabzanbeh, Kalaksorkh, Mahali-14, as well as Mahali-17 cultivated in commercial gardens in three

locations of Minab (Hormozgan province of Iran) from June to July 2015. Fruit samples were washed, cut, and stored to obtain two different green and ripening stages for next analysis step.

The samples were first oven dried at 70 °C for 24 h; then 0.5 g of each dried sample was heated at 550 °C in a muffle furnace for 4-5 h. The resultant ash was dissolved in 5 ml Analar Grade hydrochloric acid (20%), as well as distilled water was added up to 50 ml. Pb, Cr, Cd, and also As were determined using an atomic absorption spectrometer (GBC, SavantAA  $\Sigma$ , Australia) according to AOAC (1990).

All analyses were conducted in triplicate and results were expressed as means  $\pm$  standard deviation. Analysis of variance was performed with SAS 9.0. Descriptive statistics, multivariate analysis, and Duncan multiple range tests were done with a significance level of  $p < 0.05$ .

## Results and discussion

Measurement of heavy metals in all the mango samples showed various level ranges of Pb (0.008-0.05 ppm), Cr (0.01-0.1 ppm), Cd (0.002-0.014 ppm), and As (0.01-0.04 ppm). Heavy metal levels were significantly ( $p < 0.05$ ) higher in green mango samples comparing to ripe ones (Table 1). However, no significant relationship ( $p > 0.05$ ) was seen between heavy metal residues and variety in genotypes of mango samples. Decreasing heavy metals concentration with ripening could be due to the fact that mineral absorption is high during early developmental stages. It could also be attributed to dilution effect as increasing fruit cell and enhancing considerable weight (due to gaining water) during the ripening (El Buluk et al., 1996).

**Table 1:** Heavy metals concentration in different mango samples

Mango type		Sample number	Heavy metals concentration (ppm)			
			Lead	Chromium	Cadmium	Arsenic
Sibi	Green	6	0.05 $\pm$ 0.002	0.1 $\pm$ 0.002	0.016 $\pm$ 0.001	0.04 $\pm$ 0.002
	Ripe	6	0.009 $\pm$ 0.001	0.07 $\pm$ 0.003	0.004 $\pm$ 0.001	0.02 $\pm$ 0.001
Sarshahi	Green	6	0.04 $\pm$ 0.002	0.09 $\pm$ 0.003	0.01 $\pm$ 0.002	0.03 $\pm$ 0.002
	Ripe	6	0.009 $\pm$ 0.002	0.03 $\pm$ 0.002	0.002 $\pm$ 0.001	0.01 $\pm$ 0.004
Sabzanbeh	Green	6	0.03 $\pm$ 0.003	0.08 $\pm$ 0.002	0.01 $\pm$ 0.002	0.03 $\pm$ 0.001
	Ripe	6	0.008 $\pm$ 0.001	0.02 $\pm$ 0.001	0.006 $\pm$ 0.001	0.01 $\pm$ 0.003
Kalaksorkh	Green	6	0.03 $\pm$ 0.002	0.1 $\pm$ 0.004	0.01 $\pm$ 0.002	0.04 $\pm$ 0.002
	Ripe	6	0.009 $\pm$ 0.002	0.04 $\pm$ 0.002	0.004 $\pm$ 0.002	0.01 $\pm$ 0.002
Mahali-14	Green	6	0.04 $\pm$ 0.003	0.09 $\pm$ 0.003	0.014 $\pm$ 0.004	0.04 $\pm$ 0.003
	Ripe	6	0.01 $\pm$ 0.004	0.01 $\pm$ 0.001	0.005 $\pm$ 0.001	0.02 $\pm$ 0.001
Mahali-17	Green	6	0.04 $\pm$ 0.002	0.08 $\pm$ 0.004	0.008 $\pm$ 0.001	0.03 $\pm$ 0.003
	Ripe	6	0.009 $\pm$ 0.001	0.01 $\pm$ 0.002	0.006 $\pm$ 0.002	0.01 $\pm$ 0.002

There are some studies conducted in the other parts of the world to assess the heavy metal contamination of fruits and vegetables. Sajib et al. (2014) studied heavy

metals content of ten tropical fruits in Bangladesh and reported 0.02 mg/kg level of Pb in mango fruit. Shaheen et al. (2016) reported that As, Pb, Cr, and Cd in mango

fruit from Bangladesh were 0.013, 0.6, 0.8, as well as 0.005 ppm, respectively. Saha et al. (2012) reported that the concentration range of Cr in vegetable and fruit from Bangladesh was found between 0.17 to 1.93 and 0.5 to 2.5 mg/kg, respectively. Also, Akhtar et al. (2010) showed that Cd contents of mango samples in Pakistan were in the ranges of 0.17–0.22 ppm. In another research, Elbagermi et al. (2012) showed that the mean levels of Pb and Cd in mango samples of Misurata area of Libya were 1.824 and 0.362 ppm, respectively which are higher than our findings. This deference may be due to the diversity in environmental condition, irrigation water, soil pollution, fertilizer, and application of pesticide in different agricultural regions.

Among different interested heavy metals in this study, Cr showed the highest level in all mango genotypes followed by Pb, As, and Cd, respectively. Mausi et al. (2014) evaluated some selected heavy metals (Pb, Cr, and Cd) in mangoes in Kenya. They showed that heavy metal occurrence in mango fruit had the following order: Cr>Pb>Cd which is similar to the results of present study.

## Conclusion

The average amount of heavy metal residues in mango samples found in the current study were generally below the maximum acceptable levels indicating acceptable safety of these products. To the best of the author's knowledge, this is the first comparative analysis about assessment of heavy metals in both green and ripe native mango samples of Southern Iran.

## Conflicts of interest

The authors declare that they have not any conflict of interest.

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