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Role of Unprofessional Storage Methods on the Heavy Metal Content of Rosa Damascena (Gole Mohammadi)

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Abstract

As majority of people around the world rely on non-conventional medicine mainly of herbal sources for their primary healthcare nowadays, the quality of herbal medicine is one of the most important issues. The products may be contaminated with chemical toxins, excessive pesticides and heavy metals during the growth process with contaminated environment or during harvesting, storing conditions and transferring process to herbal market. Chemical toxins may come from wrong storage conditions or chemical treatment due to transferring to herbal market. The aims of this study were to : determination of the contents of Cd, Cr, Cu, Ni, Hg, Pb and Zn in Rosa Damascena available in Iranian market in comparison with these heavy metal contents in samples which is harvested from Kashan farms in order to find probable effect of transferring and storing process in contamination issue. The samples were analyzed by a Flame Emission Spectrophotometer and an automated continuous flow hydride vapor generation system was used for mercury. our results showed that the majority of medicinal plants (flowers) samples from markets had higher level of these heavy metals although these contents in samples which harvested from Kashan farms shows lower level of heavy metal contamination. It revealed that probably the transferring process and storing herbal plants are the main factors for contaminating.

Keywords: Heavy Metals, Rosa Damascena, Herbal Markets, Kashan

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1. Introduction

Rosa damascena mill L, commonly known as Damask rose , is known as Gole Mohammadi in Iran .It is one of the most important species of Rosaceae family flowers (Kaul et al., 2000; Loghmani-Khouzani et al., 2007). The major cultivation areas of Damask rose in the world are Bulgaria, Turkey, Iran and India. Kashan, Fars and Azerbaijan are the major cultivation areas in Iran. Among them, the most famous is Kashan (Yassa et al., 2009). Rosaceae are well-known ornamental plants and have been referred to as the king of flowers (Nikbakht et al., 2004; Cai et al., 2005; Boskabady et al.2011) . At present time, over 200 rose species and more than 18000cultivars form of the plant have been identified (Perumal et al., 2012). They are principally cultivated for using in perfume, medicine and food industry (Kaul et al., 2000; Loghmani-Khouzani et al., 2007) although; it is also used in traditional Iranian medicine along with rose hip which is rich in vitamin C (Kaul et al., 2000) Medicinal herbs are easily contaminated during growth, development and processing. After collection and transformation into dosage form the heavy metals confined in plants finally enter the human body and may disturb the normal functions of central nervous system, liver, lungs, heart, kidney and brain, leading to hypertension, abdominal pain, skin eruptions, intestinal ulcer and different types of cancers (Yassa et al., 2009). In spite of the increasing usage of herbal medicine in Iran, considerable research on their contaminations has not been carried out yet. Herbal medicines have been reported to contain many health hazards for herbal therapy patients. For instance, one of the health hazards is contamination to heavy metals such as Cadmium (Cd), Mercury (Hg) and Lead (Pb) (mukesh et al., 2008). Plants can contain heavy metals from their in the soil (including contamination of the plant material with soil), water or air (McLaughlin et al., 1999; McLaughlin et al., 2000). As heavy metals pose a hazard to human and animal health, their content in plants used for consumption or medicinal purposes must be limited. WHO recommends that medicinal plants which form the raw materials for the finished products may be checked for the presence of heavy metals, further it regulates maximum permissible limits of toxic metals like arsenic, cadmium and lead, which amount to 1.0, 0.3 and 10 ppm, respectively in WHO 1998 (WHO ,1989). The aims of this study were to : determination of the contents of Cd,Cr, Cu,Ni , Hg, Pb and Zn in Rosa Damascena available in Iranian market in comparison with these heavy metal contents in samples which is harvested from Kashan farms in order to find probable effect of transferring and storing process in contamination issue. In this study we focused on finding the source of this herbal medicine contamination, if they are grown under contaminated environment or during collection and storage process.

2. Materials and Methods

2.1. Sampling description

To examine the Lead, Cadmium, Zinc, Chrome, Copper, Nickel and Mercury contents in Rosa Damascena dried flowers, 50 samples were collected from 5 main agricultural areas in Kashan's farms and 50 samples were purchased from 15 different markets in Tehran of the year 2012.

2.2. Estimation of Cd, Pb, Cr, Cu, Zn and Ni

For heavy metal analyses 5 gram of each sample was weighed and oven-dried at 600c to a constant weight. Each oven-dried sample was ground in a mortar until it could pass through a 60 mesh sieve. The samples were stored in clean, dry, high density polyethylene bottles of 100 ml capacity with screw caps. All glassware and plastic containers used were washed with liquid soap, rinsed with water, soaked in 10% volume/volume nitric acid for

24hrs, cleaned thoroughly with distilled water and dried in such a manner to ensure that any contamination does not occur. One gram of powdered sample was weighed precisely on electronic balance (Shimadzu LIBROR AEX 200G) The samples were put in a 100 ml digestion flask and 5 ml of mixture was added to it and heated on a hot plate in the fuming chamber. A digestion mixture comprising of concentrated HNO3 and hydrochloric acid in the ratio of 6:1 was used for wet digestion of the samples. Blanks and samples were also processed and analyzed simultaneously. All the chemicals used were of analytical grade (AR). Standardized international protocols were followed for the preparation of material and analysis of heavy metals contents. The flasks were firstly heated slowly and then vigorously till a white residue is obtained. The residue was dissolved and made up to 10 ml with 0.1 N HNO3 and NH4I solution in a volumetric flask. The samples were analyzed by an Flame Emission Spectrophotometer Model AA-6200 (Shimadzu, Japan) using an air-acetylene flame for heavy metals – Pb, Cd, Cr, Ni, Zn and Cu, using at least two standard solutions for each metal. All necessary precautions were taken to avoid any possible contamination of the sample as per the AOAC guidelines (AOAC, 1989).

An automated continuous flow hydride vapor generation system was used for mercury and all samples were tested as quickly as possible after collection , due to not physical or chemical changes occur and the water content of samples was below of 15% for the determination of pesticide residues.

2.3. Calibration of Equipment

Standard solutions of heavy metals (1000 mg/L), namely Copper (Cu), Zinc (Zn), Chromium (Cr), Cadmium (Cd), Lead (Pb) and Nickel (Ni) were procured from Merck. Solutions of varying concentrations were prepared for all the metals by diluting the standards. For the elements under investigation we established the following sensitivity and detection limits respectively of the used FAAS apparatus. Pb 0.2 and 1.0 ppm, Cr 0.5 and 3.0 ppm, Cd 0.2 and 1.0 ppm, Cu 0.5 and 3.0 ppm, Zn 0.05 and 5.0 ppm, Ni 0.5 and 4.0 ppm.

3. Results

In 1991, the German Ministry of Health published a 'draft recommendation for limits of heavy metals in medicinal products of plant and animal origin (Bekanntmachung et al., 1991; Gasser et al., 2009), which included the following limits for plants, parts of plants, oils, fats and waxes of plant origin and products there of as well as for other products of plant origin, each with reference to the dried matter: lead 5 mg/kg, cadmium 0.2 mg/kg, mercury 0.1 mg/kg. The concentration levels of heavy metals on the samples were determined as mean ± SD of three replicates in each test and determined based on sample dry weight and has been showed in table 1. Results showed a significant increase in the Lead, Cadmium and Nickel in Tehran's markets compared to that were harvested from Kashan's farms. Except

Table 1. Heavy metal in Rosa Damascena determined in 2012. [metal concentration (mg/kg of the dried flowers)

	Pb	Cd	Cr	Cu	Hg	Ni	Zn
Market Samples	36.49±0.15	4.84±0.13	39.11±1.28	11.44±6.0	N.D	25.51±1.09	52.99±17.66
Farm Samples	7.71±0.23	1.11±0.13	38.91±1.11	13.81±39	N.D	14.87±0.61	46.22±14.34

copper contents, all metals from market samples were higher than farm samples.

3.1.Hg

The Hg concentration not detected for all samples. The national health authorities of Canada announced limitation of 0.2 ppm and China, Malaysia and Singapore 0.5 ppm in herbal medicines and products.

3.2.Cd

Cadmium concentration varies between 0.98 ppm in sample from farm to 4.97 ppm in market sample. The permissible limit laid down in the local law for Cd in herbal medicines and products is 0.3 mg/kg and in food stuff is 0.6 ppm. Cd intoxication can lead to kidney, bone and pulmonary damages (Godt et al., 2006).

3.3. Lead

The main cause for concern in terms of contamination of market samples of Rosa Damascena by heavy metals relates to Lead (Pb). Lead concentration ranged from 7.71±0.23mg/kg in samples harvested from Kashan farms up to 36.49±0.15mg/kg in market samples. 93% of samples from Tehran's markets contained Pb concentrations that exceeded the permissible limit by WHO 1998(WHO, 1998). Prescribed limit for Pb contents in herbal medicine is 10 mg/kg dry weight while the dietary intake limit for Pb is 3 mg/week. Lead is known to cause neurological disorders, anemia, kidney damage, miscarriage, lower sperm count and hepatotoxicity in higher concentration ATSDR (ATSDR, 2007).

3.4. Nickel

Nickel ranged from 14.87±0.61 mg/kg in farm samples to 25.51±1.09mg/kg in market samples. The most common ailment arising from Ni is an allergic dermatitis known as Nickel itch, which usually occurs when skin is moist, further more Ni has been identified as a suspected carcinogen and adversely affects lungs and nasal cavities. The permissible limit set by FAO/WHO (1984) in edible plants was 1.63 ppm (Bekanntmachung et al., 1991) . For Medicinal plants the WHO 2005 (WHO , 2005) limits not yet been established for Ni.

3.5. Chromium

The mean concentration of Cr (Table 1) found in different samples as 38.91±1.11 mg/kg DW level in farm samples to 39.11±1.28mg/kg in market samples. It was higher than permissible limit of 0.5 ppm as set by FDA [18].However, for medicinal plants the WHO limits are not yet been established for Cr. Although in medicinal plants, permissible limits for Cr set by Canada, were 2 mg/kg in raw medicinal plant material (WHO, 2005). The higher concentration of Cr than the critical level 5.30 ppm could be a probable cause for yields reduction. The toxic effects of Cr intake is skin rash, nose irritations, bleeds, upset stomach, kidney and liver damage, nasal itch and lungs cancer, chromium deficiency is characterized by disturbance in glucose lipids and protein metabolism (McGrath, S.P. and S. Smith, 1990).

3.6. Copper

Although Cu is an essential enzymatic element for normal plant growth and development but can be toxic at excessive levels, WHO limits for Cu have not yet been established for herbal plants. There is no permissible limit prescribed in local food law or by WHO, but WHO (1996) has recommended the lower limit of the acceptable range of Cu as 20 Mg/mg body weight per day FDA(FDA,1993; Ziarati, 2012) .

Phytotoxicity can occur if its concentration in plants is higher than 20- 100 ppm DW (dry weight). As can be seen from the data (Table 1) Cu ranged from 11.44±6.0mg/kg in market samples to 13.81±39mg/kg in farm samples . The interesting finding in this study is reduction of copper content in Rosa Damascena from Kashan's farms in comparison with samples

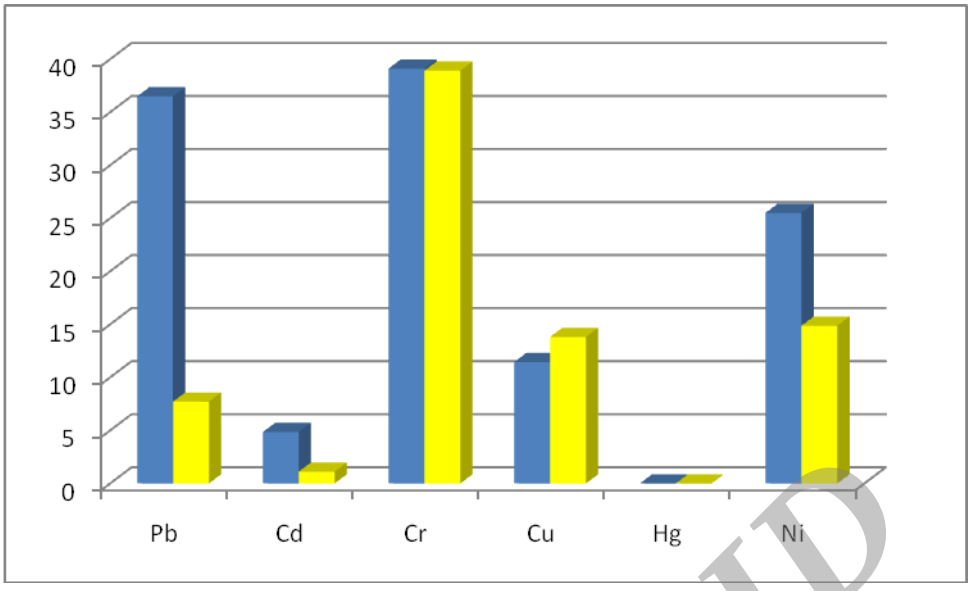

Figure 1- A comparison between heavy metals in market samples and farm samples in Rosa Damascena

from markets.

A highly significant, although low, positive correlation (r= 0.52, p=0.01, n=100) was found between lead contents in Rosa Damascena dried samples from farms and market, compared to a non-significant and much lower correlation between the samples from different farms.

4. Disscusion

By a comparison between acceptable global standards and the level of Ni, Cd and Pb on Gole Mohammadi investigated, our results showed that the majority of medicinal plants (flowers) samples from markets had higher level of these heavy metals although these contents in samples which harvested from Kashan farms shows lower level of heavy metal contamination. The results suggest that organization such as Health ministry help by carrying out premarket reviews of all medicinal - herbal plants and herbal drugs before they could be authorized for sale. As our results revealed that probably the transferring process and storing herbal plants are the main factors for contaminating. The products available in the markets should be analyzed regularly to ensure that they are free of unsafe ingredients and that the products actually contain the ingredients indicated on the labels.

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