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Short Communication

Comparative Studies of Lead and Chromium Concentration in Red Chili and Turmeric Powder

Sara Khalid[a], Shahid Tufail[b], Shabbir Hussain[a]* and Muhammad Iqbal[c]
[a]Department of Chemistry, Lahore Garrison University, DHA Phase-VI, Lahore, Pakistan
[b]Member Science (Retired), Pakistan Council of Scientific and Industrial Research (PCSIR), Lahore, Pakistan
[c]Department of Chemistry, GC University, Faisalabad, Pakistan

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Abstract. The red chili and turmeric powder available commercially in Lahore supermarkets which were randomly analyzed to evaluate the lead (Pb), and chromium (Cr) concentration by atomic absorption spectrometric technique. Lead and chromium were found to be in the ranges of 0.0050-0.01 ppm and 0.0430-0.1482 ppm, respectively. The mean concentration of lead in the red chili and turmeric powders were found to be 2.6 mg/Kg and 5.3 mg/Kg respectively, while that of the chromium was found to be 0.0419 mg/Kg and 0.1142 mg/Kg respectively. Levels of both these metals (lead and chromium) are therefore lower in the red chili compared to the turmeric powder. Also, both the samples are comparatively rich in lead as compared to chromium.

Keywords: chili, turmeric, lead, AAS

Turmeric and red chili are universally used spices in indigenous diets in tropical regions (Tuntipopipat *et al*., 2006). Pepper (chili) is an economically important crop, imparting colour, aroma and flavor to foods (Caporaso *et al*., 2013). Turmeric is generally added as a colouring agent to the cooking foods. The curcumin-an important compound in turmeric imparts it yellow colour. Turmeric finds applications in medicinal preparations, cosmetic industries and culinary preparations. However, it is sometimes contaminated with heavy metals. So, regular ingestion of the contaminated turmeric may result in serious health problems because these heavy metals are accumulated in human organs (Withanage *et al*., 2015). Heavy metals impart a significant role in environmental pollution since these produce mineral pollutants (Koc and Sari, 2009). Since the flavours and spices are important part of our daily diet and have a direct impact on human body health, their analysis is highly important; the imbalanced food can cause harmful effects on human health (Ibrahim *et al*., 2012). So, the allowed limits of concentrations for heavy metals such as Hg, Ni, Pb, Cd etc. should be define das these metals serious pathological human health (Temple and Bisessar, 1981). The higher concentration of chromium specially the hexavalent form is highly carcinogenic and toxic and may cause health risks (Achmad *et al*., 2017). Inhalation, dermal contact and ingestion are the most common exposure routes of chromium to humans. Chromium is carcinogenic in nature and also results in reproductive problems. It may cause skin allergies, lung and nasal ulcers and bronchial asthma. The higher concentration of chromium may even lead to death (Chatterjee, 2015). The higher levels of lead may create cancerous renal and tumors problems (Jalut *et al*., 2014). As the children consume more food relative to their body size than the adults so they are more exposed to lead poisoning (Mahaffey, 1977). Moreover, the children absorb and retain a higher percentage of ingested lead as compared to the adults. The children absorb about 40 percent of the ingested lead from which about 30% is retained in their systems while the adults absorb only 5%-10% of ingested lead (Ziegler *et al*., 1978). High levels of lead in children's diets may cause its accumulation in tissues, interfere with their heme synthesis and adversely affect the central nervous system (Schaffner, 1981). There are investigations on determination of the extent of safety and compliance with the standard specifications of food (Jalut *et al*., 2014). The assessment of toxic heavy metals is very important because of their negative impacts on human health as they may cause cancer and numerous disorders in human bodies (Jalut *et al*., 2014). Atomic absorption spectroscopy (AAS) was used to

*Author for correspondence; E-mail:
dr.shabbirhussain@lgu.edu.pk; shabchem786@gmail.com

measure the concentrations of mercury, iron, copper, nickel, zinc and lead in some common spices available at local markets of various countries (Jalut *et al*., 2014). Heavy metal contamination in spices is one of the most important aspects of food quality assurance. The present studies focus on determination of the concentration of lead and chromium in red chili and turmeric powder by atomic absorption spectroscopy (AAS) which is considered to be reliable analytical tool for determination of heavy metals and it is easy to use.

The analyses of lead and chromium present in red chili and turmeric powder were carried out by using atomic absorption spectrometry technique. Six different samples were collected randomly and their solutions were prepared in glass apparatus. The apparatus such as digestion flasks, measuring cylinder and volumetric flasks (25, 50 mL, 100 mL and 1000 mL) were washed thoroughly with detergents and also rinsed with deionized water. The instruments were all calibrated to check their status prior to and in the end of the experiments. All

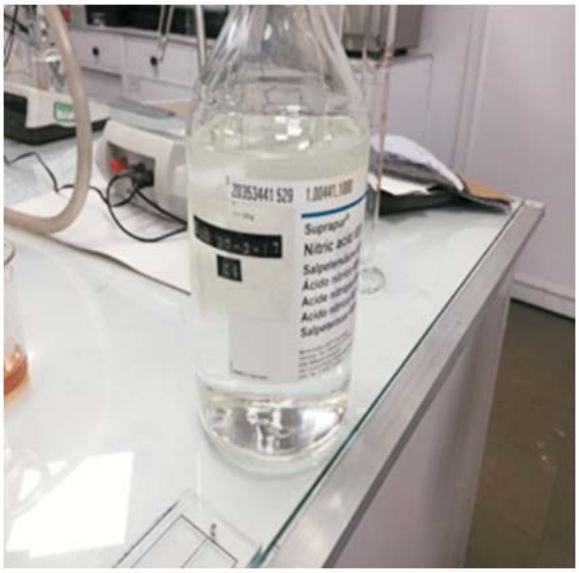

Fig. 1. Ultra-pure nitric acid.

glass ware funnel was cleaned by 10% concentrated ultra-nitric acid HNO_3 (Fig. 1) so, that the presence of any heavy metal contamination from the glass surface may be eradicated. A 1% (w/v) potassium dichromate solution in 98% (v/v) H_2SO_4 was used to soak the digestion tubes and the volumetric flasks were soaked in 10% (v/v) HNO_3 for 24 h, the digestion tubes/ volumetric flasks were then rinsed with deionized water and then dried in the oven.

The following equipment and apparatus were used in the laboratory for the required experiment:

- The digital weighing balances A & D with equipment code GEL/WB/E/08 (Fig. 2), with precision of + 0.001 g, 100 mL round bottomed flasks.
- The micropipettes (Dragonmed 1-10 mL, 100-1000 mL, Shangao, Chaina) and measuring cylinders (Duran, Germany), pipettes (Pyrex, USA).
- The atomic absorption spectrometer (buck scientific model 210VGP AAS, USA), and the lead and chromium hollow cathode lamps with air-acetylene flame.
- The filter paper what's man No. 1 and the other glassware were used.

Chemicals used in this project for the laboratory works were all analytical grade:

- The standard solution (0.5 mol/L) of Cr $(NO_3)_2$ in nitric acid
- The standard solution (0.5 mol/L) of Pb $(NO_3)_2$ in nitric acid
- The deionized water was used for the dilution of sample and the standard metal solution analysis and to rinse glassware and the sample bottles.

Fig. 2. Digital weighing-equipment code GEL/ WB/E/08.

Fig. 3. Lead (left) and chromium (right) standard solutions.

The atomic absorption spectrophotometer was calibrated by using a series of standard working solutions (Fig. 3) of each of the metals (lead and chromium) prepared freshly by a reasonable dilution of the intermediate standard solutions. The intermediate standard solutions were prepared from stock solution of each metal. The concentrations of intermediate standards, working standard solutions and values of correlation coefficients of the calibration graphs for the three metals of interest is presented in Table 1.

Six different brands of red chili and turmeric powder samples available were randomly collected from different supermarkets in Lahore. Before analysis, the material of a same brand was thoroughly mixed to get homogeneous and representative samples.

The determination of the lead and chromium metal concentration in the solution was based on its calibration curve. While, in the plotting of the calibration curves for a metal, a 1000 ppm solution of chromium or lead ion was prepared by dissolving, 1.5980 g of lead nitrate ($Pb(NO_3)$) or 7.6960 g of chromium nitrate ($Cr(NO_3)_2$) respectively in type 1st deionized water of conductivity (0.002) and then diluting it to 1 liter in a volumetric flask with de-ionized water respectively.

In order to prepare 100 ppm solution, 10 mL of the standard solutions of $Pb(NO_2)_2$ and $Cr(NO_3)_2$ were used and then stock solutions were pipetted and added into 100 mL calibrated flasks diluted with de-ionized water and the solution was mixed homogenously. The red chili and turmeric powder were analyzed by using the atomic absorption spectrometer after calibration to assess the lead and chromium concentrations (in mg/Kg = ppm) at wave lengths of 283.3 and 357.9 nm, respectively. The data are summarized in the Table 2.

Table 2 shows metal concentrations in red chili and the turmeric powder sample from six different randomly selected brands. Lead (Pb) levels showed significant difference between the red chili and turmeric brands. If we compare the mean concentration levels of metals in both the varieties of tested samples (Table 1) then it can easily be concluded that red chili contains significantly lower concentration of lead (2.6 mg/Kg) as compared to that of lead (5.3 mg/Kg). The mean concentration levels of the chromium were found to be 0.0419 mg/Kg in red chili powder and 0.1142 mg/Kg

Table 1. Concentration values of working intermediate standard solutions, working standard solutions and correlation coefficients of calibration graphs

Metal	Conc. of intermediate standard	Conc. of working	Correlation coefficients of calibration curves (R^2)
Lead (Pb)	10	20, 10, and 5	0.9968
Chromium	10	2.5,1.5 and0.5	0.9988

Table 2. Concentrations (ppm) of metals in red chilli and turmeric powders (Mean±SD)

	Concentration of lead (Pb) in ppm		Concentration of chromium (Cr) in ppm	
Sample no.	Red chili	Turmeric	Red chili	Turmeric
1	2±0.01	8±0.016	0.0448±0.02	0.0104±0.02
2	2±0.01	4±0.017	0.0380±0.02	0.1842±0.02
3	4±0.01	6±0.0050	0.0430±0.02	0.1482±0.02
Mean	2.6	5.3	0.0419	0.1142

Fig. 4. Sample solutions (in deionized water) are being filtered to separate soluble portion.

in turmeric powder. It means that chromium levels are significantly lowered in the red chili as compared to the turmeric powder.

The literature shows that the lead concentration in turmeric from Sri Lankan market was found to be 26 µg/Kg (Senanayake *et al*., 2013). Certainly, there is a reduction in Pb concentrations when treated with microbial bio fertilizers. That is because the micro-organisms have the potential to reduce the Pb content in the rhizosphere soil. To the greater extent, the Pb concentrations were less when treated with Azospirillumsp in turmeric. The bio-fertilizer treatments also have the potential to reduce the Pb accumulation inside the turmeric rhizome. Lead is heavy metal poison which forms complexes with oxo-groups in enzymes to affect virtually all steps in the process (Withanage *et al*., 2015).

The atomic absorption spectrometric technique was successfully applied to measure the concentration of lead (Pb), and chromium (Cr) in six different brands of red chili and turmeric powder available commercially in Lahore supermarkets. The concentrations of lead and chromium were found to be 0.0050-0.01 ppm and 0.0430-0.1482 ppm, respectively. Levels of both these metals (lead and chromium) are therefore lower in the red chili compared to the turmeric powder. Although the metabolic function of both of these metals is unknown, however, the presence of either chromium or lead causes disruption of normal cellular processes in the body. The accumulation of these metals in biological tissues (bio-accumulation) may lead to harmful effects and toxicity in various organs.

Conflict of Interest. The authors declare no conflict of interest.

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