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ESTIMATION OF HEAVY METALS IN BLENDED EXTRACT AND COMPARED AFTER MANUFACTURING PROCESS

Sasikala. S Research Scholar, Bharathiar University, Coimbatore, India

Radhaisri.S Associate Professor, Department of Food & Nutrition, PSG College of Arts and Science, Coimbatore

ABSTRACT Heavy metals are naturally present in the environment. Natural extracts, besides it's sought after pharmacological effect and uses in medical treatment, could be dangerous because of heavy metals and other impurities. The aim of this study is to investigate and compare the heavy metal content and contamination in our developed nutraceutical product before and after the manufacturing process to ensure safety. In this study, the content of heavy elements, iron, zinc, copper, manganese, nickel, lead and cadmium were determined before and after manufacturing capsules using ICP–OES and ICP–MS techniques. The results were compared with the FSSAI safety limits and were found to be within the permissible limits. This study highlight that the content of heavy metals before and after manufacturing capsule does not exceed the safety limits and its concentration is far below the permissible limits, thus ensuring safety.

KEYWORDS : Heavy metals, nutraceuticals, mangosteen, grapeseed

INTRODUCTION

Global and national markets for nutraceutical products have been growing rapidly. As a consequence, the safety and quality of the nutraceutical products have become increasingly important concerns for health authorities and the public alike. Heavy metal contamination of food items is one of the most important considerations in food quality assurance (Marshall, 2004). These metals may reach and contaminate plants, vegetables, fruits and canned foods through air, water and soil during cultivation (Husain, *et al*., 1995) and also during industrial processing and packaging.

Heavy or toxic metals are stable elements and bio-accumulative. These include: mercury, nickel, lead, arsenic, cadmium, aluminium, platinum, and copper. Heavy metal pollutants can contaminate the products during processing by inhalation of air and penetration through the skin's surface (Raikwar, *et al*., 2008). Hence, during the manufacturing process of dietary supplements, the manufacturing companies should take most or all the quality assurance measures to avoid contamination due to heavy metals (Liva, 2007). Thus, the aim of this study is to investigate and compare the heavy metal content and contamination in our formulated nutraceutical product before and after the manufacturing process to ensure safety and to highlight any consequent health concern.

MATERIALS AND METHODS

Preparation of samples

Sample I: The raw samples of mangosteen and grape seed extract were blended and tested for heavy metals prior to the manufacturing process.

Sample II: The Formulated and Packed Nutraceutical product which contains mangosteen and grape seed extract of 400mg and 100mg respectively were tested for heavy metals.

Analysis of samples: The analysis of our samples was done at SGS lab and the samples were analysed using ICP-OES and ICP-MS methods. In this study, the analysis of metals, iron and zinc are done by, Inductively coupled plasma optical emission spectrometry method and the analysis of metals arsenic, cadmium, mercury, lead and copper were done by using Inductively coupled plasma mass spectrometry method

ICP-OES method for analysis of heavy metals: In this method, the preparation of samples was done by microwave digestion method. After that, the instrument parameters were set according to the requirements. The emission for sample blank of a series of respective metal solutions of working range in ICP-OES was read. The absorbance of metal was plot against the solution. Yttrium was used as internal standard. The concentration against the prepared calibration curve is read. Finally, QC check standard was run after 20 samples. Then analysis of spiked sample was done by adding known concentration of metals in sample and following microwave digestion method.

ICP-MS method for analysis of heavy metals: In this method also, the preparation of samples was done by microwave digestion method. Following this process, the ICP-MS parameters settings were done. Then the sample was introduced and detector settings were made according to the type of metal that is going to be detected. The next step is the preparation of calibration curve, which is done by reading the emission of sample blank of a series of respective metal solutions of working range in the ICP-MS. Absorbance is plot against micrograms of metal per ml of sample solution. The concentration against the prepared calibration curve is read. Finally, QC check standard was run after 20 samples. Then analysis of spiked sample was done by adding known concentration of metals in sample and following microwave digestion method. Both of these methods were almost similar and a Hydride generator technique should be used for analysis of mercury, arsenic, selenium and antimony.

Calculation: The calculation of heavy metals is similar for both the methods. It is represented as follows

$$\text{Heavy metals (mg/L)} = \frac{\text{Concentration (mg)} \times \text{Volume (V)} \times \text{Dilution factor (DF)}}{\text{Weight of the sample (mg)}}$$

Thus the multi-element analysis capabilities of both techniques make them ideal tools for processing multiple analyses in a large numbers of samples quickly and efficiently (Cassap, 2011)

RESULTS AND DISCUSSION

Heavy metals have been widely acknowledged to adversely affect the nutritive values of agricultural produce on account of their deleterious effect on human beings. As such, an increasingly important aspect of food quality assurance has been to control the concentrations of heavy metals in food (Sobukola, *et al.*, 2010).

In this study, the content of heavy elements, iron, zinc, copper, manganese, nickel, lead and cadmium, were determined in the mangosteen and grape seed extract before (Sample I) and after (Sample II) manufacturing capsules. The heavy metal content in raw material which contains mangosteen and grape seed extract powder blend (Sample I) has been compared with the FSSAI limits and was found to be within the permissible limits.

The level of heavy metals in the finished product (Sample II) of

mangosteen and grape seed extract which is also found to be within the FSSAI safety limits for heavy metals. It shows that the highest and lowest content of heavy metal in mangosteen and grape seed extract were copper and lead respectively and they are found to be within the safety limits.

Copper, Iron and Zinc: The copper and iron content in Sample I is found to be 9.66 mg/kg and 1.73 mg/kg respectively. In sample II, the copper content is 30 mg/kg and iron content is 1.74 mg/kg. On comparing these results with the FSSAI safety limits, the content of copper and iron in the sample are within the safety limits. There are no traces of Zinc in both the samples. Copper is an essential micronutrient which functions as a biocatalyst, in addition to iron it is required for body pigmentation, it maintains a healthy central nervous system, prevents anaemia and interrelated with the function of zinc and iron in the body (Akinyele, 1982). Hence these contents are beneficial to human health.

Lead, Arsenic, Cadmium and Mercury

Lead content in both samples (Sample I and Sample II) has been evaluated as 0.08 mg/kg and traces of other metals like Arsenic, Cadmium and Mercury were not found to be present in the sample. Based on FSSAI safety limit, the lead content in our sample should be within the safety limit of 2.5 mg/kg and hence the lead content in mangosteen and grape seed extract is found to be within the permissible limit.

Cadmium is a non-essential element in foods and natural waters and it accumulates principally in the kidneys and liver (Divrikli, et al., 2006). Arsenic and mercury are also non-essential elements in food sample and various sources of environmental contamination have been implicated for its presence in foods (Adriano, 1984). Lead toxicity causes many diseases like anaemia, anoxia, bone pair, brain damage, convulsion and dizziness. The toxicity of zinc due to excessive intake may lead to electrolyte imbalance, nausea, anemia, and lethargy (Onionwa, et al., 2001).

Finally, in the given sample of mangosteen and grape seed extract, heavy metals like, cadmium, arsenic, mercury and zinc are absent and apart from this, copper, lead and iron were present at very minimum levels and are within safety limits of FSSAI.

Comparison of heavy metals - Iron, Zinc & Copper in Sample I and Sample II: The content of heavy metals like iron, zinc and copper in sample I and sample II does not show much difference, it is represented in figure 1.

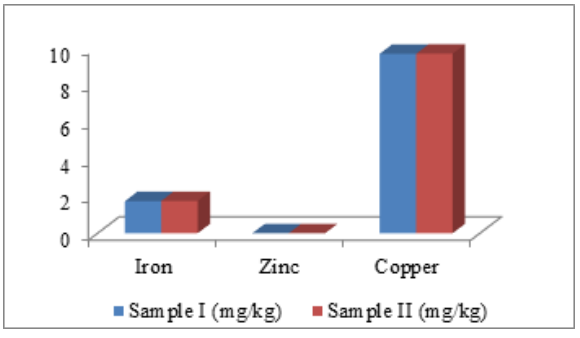

Figure 1 Comparison of iron, zinc and copper content in samples I & II

Comparison of heavy metals - Arsenic, Cadmium, Mercury and Lead in Sample I and Sample II: The content of heavy metals like iron, zinc and copper in sample I and sample II were compared which does not show much difference, it is represented in figure 2.

Heavy metals are non-biodegradable and its bio-accumulation increases in nutrition deprived state therefore, developing countries with higher prevalence of under nutrition are at a greater risk of heavy metal toxicity (Chandorkhar, S 2013).

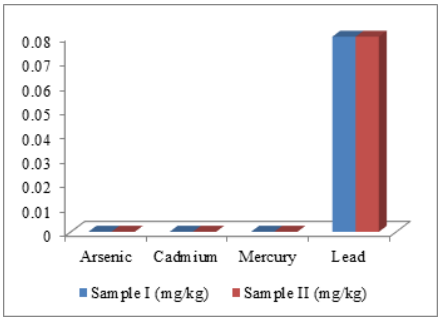

Figure 2 Comparison of heavy metals - Arsenic, Cadmium, Mercury and Lead in

Sample I and Sample II

However, contamination of the environment is fast increasing, especially through the use of chemicals in agriculture and industry. Here, in our study, although the results show the presence of only heavy metal lead in both samples, its concentration is far below the permissible limits.

Thus, periodic monitoring of heavy metal concentrations in all herbal and nutraceutical products is essential and highly recommended, to assess the temporal trends in human exposure to these metals. This is necessary due to increasing use of fertilizers, pesticides and veterinary chemicals in our food production.

CONCLUSION

This study shows that there is no abnormal accumulation of toxic heavy metals like arsenic, cadmium, lead and mercury in the samples of mangosteen and grape seed extract both before and after manufacturing capsules. The samples are found to be free from heavy metal contaminations due to natural sources of heavy metal contamination like soil, air, water or waste water irrigation etc., and artificially due to machineries during the process of extraction. Therefore this study concludes that there is no possible health risk to humans due to heavy metals to consume this product and it is said to be tested for safe consumption.

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