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Analysis of Heavy and Trace Metals in Golden Ingredient Turmeric (*Curcuma longa*) of Mumbai, Maharashtra

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Abstract

Indian Turmeric (*Curcuma longa*) also called as haldi, has been consumed by people as a dietary component of spices and also used in the medicine as a household remedy. Turmeric has a vital role in the cure of digestive system by its anti-ulcer role. It is useful in alzheimer disease, parkinson disease and other oxidative stress related diseases due to its antioxidative and anti-inflammatory roles. The aim of present study is to check the composition of turmeric by the study of various metals present in samples. The concentration of different metals were found in following order Mg > Ca > Fe > Mn > Zn > Cr. Cadmium (Cd), copper (Cu), lead (Pb), arsenic (As) and mercury (Hg) were found be below the detectable level. Our study suggests that turmeric is a golden ingredient of spices and has a great significance and contribution to human health.

Key words: Metal, Antioxidant, Turmeric

Introduction

Spices are used for enhancing the colour, flavour and the other organoleptic properties of food (Withanage *et. al.*,2015). Turmeric is a well known spice which is added to foods in cooking as a colouring agent, obtained from the dried rhizome of *Curcuma longa L.* which belongs to the ginger family (Withanage *et. al.,* 2015). In India it is popularly known as "Haldi" and is extensively cultivated in all parts of India (API, 1989). In the world, India is a major producer, consumer and exporter of turmeric (Datta *et. al.,* 2017). Turmeric (*Curcuma longer* L.). It has a typical colour and flavour and has various uses in dying industries, medicines, culinary preparation and in cosmetics. It is also used in treatment of cataracts, breast cancer, colon cancer, and lymphoma (Halder *et. al.,* 2007; Devi *et. al.*,2011). Turmeric has anti-inflammatory, anti-oxidative effects, anti-proliferative and anti-microbial activities (Dulbecco and Savarino, 2013; Kalkan, 2015). The yellow colour of turmeric is due to a compound known as curcumin (Withanage *et. al.,* 2015).

Turmeric can be grown in variety of soil but light textured soil and shady places are preferred for cultivation (Halder *et. al.,* 2007). Many studies suggested that spices like ginger and turmeric are highly responsive to chemical fertilizers. Beside this micronutrient are widely used as fertilizers to reduce diseases in plants and enhances post harvest life of turmeric (Halder *et. al.,* 2007; Banafer and Tiwari 1995; Sheshagir and Uthaiah, 1994). According to Halder *et. al.*,(2007) inadequate and imbalanced use

of chemical fertilizers along with micro-nutrients can reduced the yield of turmeric. Regular usage of these contaminated spices result in accumulation of this micro and macro metals in human organs and may results in serious health problems (Withanage *et. al.*, 2015). The composition of trace elements in food is very important factor due to their toxic or essential nature. Environment pollution is the main cause of metal contamination in food. The other processes which are used in food industries may also increases the amount of trace metal in food. Kavitha (2012) suggested that in the rhizomatous crop kacholam (Kaempferia galanga L.) use of sulphur and magnesium resulted in higher rhizome yields. Chhibba *et. al.*,(2007) also shown that application of Fe significantly increases yield of crops.

Materials and Methods

The present study was carried out to assess the levels of macro, micro and toxic heavy metals in some of widely used branded and unbranded turmeric powders available in Mumbai, Maharashtra. A total of 11 minerals calcium, cadmium, chromium, copper, iron, magnesium, manganese, lead, zinc, arsenic and mercury were analysed by using Inductively Coupled - Plasma Atomic Emission Spectroscopy (ICP-AES).

Sample Preparation

0.1gm of turmeric sample was taken from nearby dairy farm and 4 ml of concentrated HNO3 was added to it and heated on hot plate. After boiling 1 ml of HClO4 (perchloric acid) was added and heating continued to destroy the organic matter from the sample. Sample were diluted with distilled water to make the total sample volume to 10 ml. Blank was prepared by adding 4 ml. of concentrated HNO_3, 1 ml of $HClO_4$ and 5 ml distilled water to make the total volume to 10ml.

Standard was prepared separately for each selected metals by diluting readymade stock metal solution of 1000 ppm. The stock solution of 1000 ppm was diluted with deionised water to varying concentrations of 0.10, 1.00, 10 and 100 ppm. Intensities of varying concentration of standard metal solutions were analyzed by ICP-AES. Results were expressed in mean ± SD.

Result and Discussions

In present research work the concentration of Cd, Cu, Pb, As and Hg were found below the detectable limit in all turmeric samples. Other micro and macro elements are found are Mg 2317.737 ± 8.511 , Ca 1768 ± 63.79 , Fe 177.2524 ± 0.598, Mn 34.1366 ± 0.49, Zn 22.385 ± 3.51, and Cr 1.5852 ± 0.06.

Table: 1 Composition of minerals (ppm) in widely used branded and unbranded turmeric powders

1	Ca	Cr	Fe	Mg	Mn	Zn
2	1875.22	1.767	178.628	2306.695	33.281	28.127
3	1610.16	1.65	176.734	2320.046	35.347	13.785
4	1870	1.547	175.568	2306.65	33.265	28.125
5	1872.35	1.362	176.712	2305.258	33.458	28.108
6	1614.11	1.6	178.62	2350.034	35.332	13.78
MEAN	1768.368	1.5852	177.2524	2317.737	34.1366	22.385
S.E.	63.79027	0.066613	0.598355	8.511758	0.492254	3.511958

In present study magnesium has highest mean concentration values. The Mg levels ranged between 2306.695-2320.046 ppm in all the analyzed brands. Result suggests that there is no effect of grinding on Mg content in turmeric. The present result of Mg concentration is also supported by the literature (Millican, 2012; Withanage *et. al.,* 2015). In human body many biochemical reactions such as protein synthesis, muscle and nerve function, blood glucose control contain magnesium as the co-factor (FAO/WHO, 1998).

In case of Ca the level was in the range between 1875.22 – 1610.16 ppm. Calcium is a very crucial element for our body, it provide strength to bones and teeth. 99% of body calcium is stored in bones and teeth, remaining one percent of calcium is circulating in fluids in order to ionise calcium (Millikan, 2012). Elvingson (2013) also reported that calcium concentration is related to animal growth, because it is essential for the development of offspring.

In current study, Fe concentration were found in the range of 178.628 -176.734 ppm. The grinding process may increase the Fe concentration. This can be caused due to grinding equipment during the processing. According to WHO the recommended permissible amount of Fe is (300 µg/g). Iron is also added as a micro nutrient at the time of planting in the form of $FeSO_4$ (Withanage *et. al.,* 2015). Iron plays a fundamental role in cell respiration, chlorophyll synthesis and in production of carbohydrate. Its deficiency is mainly observed in calcareous soils in all crops (Kamble *et. al.,* 2014).

Manganese concentration was observed in the range of 33.281 – 35.347 ppm. Mn content in turmeric were below the WHO limit of Mn 100 µg/g. The result are also supported by Ibrahim *et. al.*,(2012) as 26.8±1.4 µg/g, and Withanage *et. al.,* (2015) 14.8 - 27.6 µg/g dry weight in turmeric. It has been suggested that turmeric has an ability to reduce free radicals and reactive oxygen species (ROS). By this mechanism it has a protective role towards neuronal tissues against toxic chemicals as manganese (Kalkan, 2015).

Zinc play an important role in public and biologic health as it maintain the cellular intregrity of many organs such as prostate, testis, pituitary pituitary (Kumari *et. al.,* 2012; Joshi *et. al.,* 2014a, 2014b; Kuldeep *et. al.,* 2018) and it also responsible for normal functioning of mammalian erythrocytes (Nair *et. al.,* 2019). In present work zinc content was observed in the range of 13.785 – 28.127 ppm. According to WHO the limit of zinc is 50 µg/g. Withanage *et. al.,* (2015) found 9.3 - 12.2 µg/g of zinc in turmeric samples. Millican (2012) suggests the range of zinc in spices are 10 -1010 µg/g. The present value observed in our turmeric samples were the lower side of that range. Zinc is used as a fertilizer in the form of

$ZnSO_4$. Its deficiency leads to decrease in food intake and intermittent diarrhoea, and degenerative changes in reproductive accessory gland i.e. prostate (Joshi *et. al.*, 2014a, 2014b). The Zn in turmeric may be affected by the use of this kind of fertilizer. In present research work the concentration of Zn was in lower limit and it may be considered as tolerable.

Chromium especially Cr (III) plays an crucial role in the body. It is a trace element, however, it's excess amount is toxic (Mubeen, 2009). The WHO limit of Cr is 30 µg/g for spices. In present work the Cr concentration were observed between the range of 1.650 – 1.767 ppm . This reduction of Cr in the turmeric may be due to the take up of Cr into their cells by the microbial bio fertilizers Sumathi, 2012; Withanage *et. al.*,, 2015). Additionally, the reduced concentrations may possible because microbial bio fertilizers can able to resist or restrict the uptake of heavy metals by plant roots (Sumathi, 2012).

Conclusion

Turmeric is a natural antioxidant and non-toxic in nature. It has a great efficiency in prevention of many diseases. It has various essential micro and macro nutrients.These nutrients are very crucial for main ting human health. In present study the markedly available samples of turmeric had various nutrient compositions such as Mg, Ca, Fe, Zn, Cr, and Mn. The entire samples were free from toxic metal ions such as cadmium, lead, arsenic and mercury. Overall, the biological safety, its composition of minerals and its use in India probably give good explanation that turmeric is a miraculous gold ingredient in all spices.

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