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Analysis of Metal Content in Turmeric Powder Available in the Sri Lankan Market

By

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DECLARATION

The work described in this thesis was carried out by me as a project under the supervision of Prof. Arthur Bamunuarachchi, Dr. Indira Wickramasinghe and Mr. R.M.G.B. Rajanayake and a report on this has not been submitted in whole or in part to any University or any other institution for another degree.

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We Prof. A. Bamunuarachchi, Dr. Indira Wickramasinghe and Mr. R.M.G.B. Rajanayake joinytly here by certify that the above statement in the preceding page made by the candidate is true and this thesis is suitable for submission to the university for the purpose of evaluation.

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ABBREVIATIONS

WHO	-	World Health Organization
AOAC	-	Association Of Analytical Communities
AAS	-	Atomic Absorption Spectrometry
GFAAS	-	Graphite Furnace Atomic Absorption Spectrometry
XRF	-	X-Ray Fluorescence
ANOVA	-	Analysis of variances
DW	-	Dry Weight
DL	-	Detection Limit
ppm	-	parts per million
ppb	-	parts per billion

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Melani Nisansala Withanage

ABSTRACT

Turmeric powder is a bright yellow coloured powder made by grinding of dried mature turmeric rhizomes. Turmeric is an important condiment used mainly for culinary preparations and also as a dye with varied uses in cosmetic industries and for medicinal properties. Sometimes turmeric may be contaminated with micro and toxic heavy metals excessively. Heavy metal contamination in the food chain is mainly caused by environmental pollution. Micro metals composition of turmeric are very important because of their essentiality or the toxic nature. In the processing of turmeric powder from the dried rhizome these metals content may be varied.

Turmeric is available as branded and unbranded powders. Therefore this study was carried out to assess the levels of macro, micro and toxic heavy metals in some of those widely used branded and unbranded turmeric powders available in the Sri Lankan market. Three batches from five different brands and an unbranded turmeric powder were subjected to the analysis. A pure turmeric rhizome was used as the control. AOAC Official method of 975.03 was carried out to determine these metal content using flame and graphite furnace atomic absorption spectrometry. The macro metals sodium (Na), magnesium (Mg), potassium (K), calcium (Ca) and micro metals namely iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were analyzed by flame AAS.

The other micro metal chromium (Cr) and toxic heavy metals namely nickel (Ni), lead (Pb) and cadmium (Cd) were analyzed by graphite furnace AAS. The metals potassium, calcium, iron, manganese, copper, zinc, chromium, nickel and lead were also analyzed by X-Ray Fluorescence spectrometry (XRF). The results were statistically analyzed using analysis of variance (ANOVA). Tuckey's pair wise comparison, Dunnet's comparison, the equal variance test and one sample t test was applied to analyse the results. Paired t test was used to compare the results obtained by AAS and XRF for the metal analysis in turmeric.

According to the results, potassium was the most abundant macro metal in turmeric and the values ranged from 36155.8 to 42788.8 μg/g in different brands. There were increment of sodium and iron content in turmeric during the grinding process. In the case of iron the pure rhizome contained 205.6 μg/g of iron while branded an unbranded turmeric powders ranged from 222.1 to 463.0 μg/g. Except iron the other micro metals were present in very low level in turmeric. Iron content only in unbranded turmeric powder was exceeded the maximum limit and the value was 461.7 μg/g. Cadmium content exceeded the maximum limit in some brands as detected in brand B (423.3 μg /g) and brand C (788.0 μg/g). Lead was not detected in most of branded turmeric powders. According to the statistical analysis, only iron and cadmium contents in some brands were significantly exceeded the maximum limit recommended by World Health Organization (WHO). There were significant differences among all the brands and unbranded turmeric powder in majority of metal contents. The variation among batches in same brand for the all metals was not significant. It was statistically proved that the both AAS and XRF methods give the similar results for the metal content.

CHAPTER 1

INTRODUCTION

Spices are generally used to enhance the colour, flavor and the other organoleptic properties which increase the acceptability of food. Therefore they are used as diet components. They are dried plant parts such as rhizomes, barks, leaves, fruits, seeds or other part of spicy crops. Most of these are fragrant, aromatic and pungent plants.

Turmeric is a well known spice which is added to foods in cooking mainly as a coloring agent. It is produced from the dried rhizome of *Curcuma longa* L which belongs to ginger family. It is a flowering plant which has white flowers and the height of the plant is about 40 inches. Turmeric is widely distributed in tropical and subtropical regions especially in South and Southeast Asian countries, Africa and America. In Sri Lanka turmeric is cultivated in nearly every part of the island except in areas of very high elevations. Turmeric is cultivated under coconut as an inter-crop commercially. The harvested form is the rhizome and after several processing steps a yellow colour powder is obtained which is called turmeric. The yellow colour is given to the turmeric by curcumin. Turmeric can be used as a herbal medicine as rhizome and also used in religious activities. In addition turmeric oil and curcumin are produced from the turmeric rhizome.

Dried turmeric has pungent flavor and they contain carbohydrates and the other organic compounds with various functional groups. These may be contaminated with trace and heavy metals excessively. Regular usage of these contaminated turmeric result in accumulation of these metals in human organs and may results in serious health effects.