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

By

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DECLARATION

The work described in this thesis was carried out by me under the supervision of Prof. Arthur Bamunuarachchi, Dr. (Mrs.) 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 Institution for another Degree.

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08/12/2015

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We, Prof. Arthur Bamunuarachchi, Dr. (Mrs.) Indira Wickramasinghe and Mr. R.M.G.B. Rajanayake, jointly certify that the above statement made by the candidate is true and that this these is suitable for submission to the University for the purpose of evaluation.

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LIST OF ABBREVIATIONS

WHO - World Health Organization

AAS- Atomic Absorption Spectrometry

XRF - X-ray Fluorescence

ED – Energy Dispersive

WD – Wavelength Dispersive

DW - Dry Weight

LD – Lethal Dose

ND – Not Detected

ANOVA - Analysis of variance

AOAC – Association of Analytical Communities

ppm – parts per million

ppb – parts per billion

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ABSTRACT

Chillie (*Capsicum annuum* L.) powder is the dried, pulverized fruit of one or more varieties of chillies and it is used as a spice to add pungency flavour to the dish. Although chillie is grown in Sri Lanka, the annual production of dry chillie in Sri Lanka is not sufficient to fulfill the national annual demand. Therefore a major portion of chillie is imported from India, thus many branded chillie powders available in the Sri Lankan market are products of imported dry chillies from India. This study was conducted to investigate the macro, micro and toxic metal content of chillie powder samples commonly available in the Sri Lankan market.

Five brands of chillie powder samples named A, B, C, D and E, and an unbranded sample were selected for this study. Three batches from each brand and three samples from each batch were purchased from the local markets in Sri Lanka. Three samples of the unbranded sample were also collected. An ungrounded whole dry chillie sample was selected as the control. The contents of macro metals (Na, K, Mg and Ca), micro metals (Fe, Mn, Cu, Zn and Cr) and toxic metals (Ni, Pb and Cd) in the chillie powder samples were determined using the flame AAS, graphite furnace AAS and XRF spectrometric techniques. Results were statistically analyzed using one-way analysis of variance (ANOVA), at 0.05 probability level with MINITAB-14 software package.

According to the results, there was no significant difference between the batches tested in each brand, in mean Na, K, Mg, Ca, Fe, Mn, Cu, Zn, Cr, Ni, Pb and Cd contents. But there were significant differences among the brands in mean metal contents. These variations may be due to multiple factors, such as the differences in soil conditions where it was grown, variety of chillie, maturity of chillie, growing season, climatic condition, processing treatments and preservation method. The mean Fe content of brand A (728.3 ± 1.2 μg/g), brand B (616.6 ± 1.9 μg/g) and unbranded samples (365.3 ± 0.5 μg/g) were significantly higher than the WHO maximum permissible limit. This may be due to the metal (Fe) contamination during the grinding process. Thus brand A, B and unbranded samples are not suitable for daily consumption. In all the tested chillie powder samples Mn, Cu, Zn and Cr contents were found to be present in ppm level, while Ni and Pb in the ppb level, which were below the maximum permissible limits, but in all samples Cd content (ranged between 228.2 and 527.3 μg/kg) exceeded the maximum permissible limit (200 μg/kg). The control sample also contained relatively high amount of Cd content, but below the maximum limit. The Cd content in chillie powder samples can be significantly higher in those which were grown on high Cd soils and differences occur due to the types of fertilizers used.

CHAPTER 1

INTRODUCTION

Chillie (*Capsicum annuum* L.) is considered as one of the most important commercial spice crops and is widely used as a universal spice, named as *wonder spice*. Different varieties are cultivated for varied uses like vegetable, pickles, spice and condiments. In Sri Lanka, chillie powder is commonly used in homes and in food industries as a spice to add pungent taste and flavour to the dish, and also to give the dish colour.

Although chillie is grown in Sri Lanka, the annual production of dry chillie in Sri Lanka is not sufficient to fulfill the national annual demand. Therefore a major portion of chillie being imported from India, thus many branded chillie powders available in the Sri Lankan markets are products of imported dry chillies from India. The main environmental pollutants in whole chillie are thought to be toxic trace metals that may be coming from agronomic sources particularly agricultural, chemicals and processing operations. Some of the important trace metal pollutants are lead, copper, arsenic, tin, zinc, cadmium and mercury. Thus imported chillie may contain these toxic metals. When processing chillie in Sri Lanka to produce powdered chillie, trace amounts of metals may be added during the grinding process. Therefore it is very important to analyze the metal content in chillie powder to check whether they are within the standard limits. Chillie is an essential ingredient in Sri Lankan meals and as chillie powder is daily consumed by Sri Lankans through the meals, it is also very important to gather information about the mineral