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Quantitative Analysis of Chromium and Cadmium Content of Ten Selected Herbal Supplements from Malate, Manila, Philippines

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Abstract. Over the recent years, worldwide interest in herbal products has grown significantly, particularly here in the Philippines. However, there are still issues regarding the presence of some contaminants in such herbal products that could bring about toxic effects when ingested. This study aims to determine the presence of cadmium and chromium in ten selected herbal supplements using quantitative methods. Results from the quantitative analysis indicated that cadmium was not detectable in all samples while chromium was detectable in LVM DS, MV and ABH. The samples with detectable amount of chromium did not exceed the safety allowable limit of the toxicant stated. From the findings of this study, it may be concluded that some of the herbal supplements tested contains detectable amounts chromium. .

Keywords: Herbal Supplements, Chromium, Cadmium

1. Introduction

1.1. Background of the Study

Even before the introduction of modern medicines and the reign of Western curative methods, herbal medicines had been widely used in the Philippines [1]. The Traditional and Alternative Medicine Act of 1997 defines herbal supplements or medicine as finished and labelled medicinal products that contain as active ingredient/s serial or underground part/s of plant or other materials or combination thereof, whether in the crude state or as plant preparations. The said act also states that these herbal medicines may contain excipients in addition to the active ingredient/s. However, those medicines containing plant material/s combined with chemically-defined active substances, including chemically-defined, isolated constituents of plants, are not considered to be herbal medicines [2].

The use of such medicines has been gaining popularity locally and internationally as more clinical proof emerges that validates their effectiveness but the regulation of these herbal medicines has been brought to the public eye due to incidents concerning their safety. It has been found that some herbal supplements such as those utilized in Traditional Chinese Medicine, Ayurvedic medicine, and the like contain certain contaminants that may cause adverse effects [3].

The industry of food supplements continues to grow globally. In 2002, the estimated prevalence of food supplement use among US adults was 73%. The rate by which these food supplements are made available in the market to meet the increasing public demand reflects consumers' positive attitude towards the benefits of food supplements, and their role in promoting wellness and illness prevention[4,5].The growth of food supplement industry is also seen in the Philippines. Food supplements have grown into a billion peso industry in the Philippines. However, the standardization and regulation of food supplements has not changed and remains to be inadequate to adapt to this worldwide trend.

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The rapid increase in the number of commercially-available herbal supplements poses a hazard to public health due to the possible contamination of these products with harmful toxicants. In an article by the New York Times, it was reported that a Congressional investigation of dietary supplements revealed that nearly all of the samples contained trace amounts of lead and other heavy metals as well as pesticides. The levels of heavy metals detected did not exceed the thresholds considered dangerous when taken at the levels suggested by the product labelling. The possible accumulation effects were not examined. The investigators also found that 16 of the 40 supplements tested contained pesticide residues that appeared to exceed legal limits [6,7].Knowledge about the toxicologic effects of a compound influences the consumer products, drugs, manufacturing process, waste clean-up, regulatory action, civil disputes and broad policy decisions. Various societal issues related to toxicology are accompanied by the responsibility to be more sensitive to the ethical, legal and social implications of toxicologic research and testing. Toxicological researches in the biological sciences have highlighted the need for the defined ideas of human, animal and environmental health. [8].

1.2. Statement of the Problem

Over the recent years, worldwide interest in herbal products has grown significantly, particularly here in the Philippines. The advanced knowledge about their composition has been acquired through the introduction of new analytical techniques. At present, however, there are still issues regarding the presence of some contaminants that could bring about toxic effects.

This study is guided by the following questions:

1. What toxicants are present in the ten selected herbal supplements?
2. What is the amount of chromium and cadmium present in the ten selected herbal supplements?
3. How does the amount of toxicants found in ten selected herbal supplements compare to the available quality standards of the WHO?

1.3. Objectives

This study aims to achieve the following:

General Objective:

1. To determine the presence of cadmium and chromium in the ten selected herbal supplements

Specific Objectives

1. To quantify the chromium and cadmium content of ten popular herbal supplements in Manila

2. To compare the results with the available quality standards of the USFDA in terms of acceptable quantity

1.4. Hypotheses

The ten herbal supplements do not contain detectable amounts of cadmium and chromium. All of the samples do not exceed the safety allowable limits of the toxicants stated.

1.5. Significance of the Study

Due to increasing public demand for herbal supplements in the country, the public is left vulnerable to the threats that contaminated products pose. It is imperative to ensure that the preparations available are safe and the components contained in which are within suggested limits. The data that will be gathered in the study will aid in promoting awareness regarding the safety of these herbal supplements and ultimately help in safeguarding public health informing relevant authorities, such as the FDA, by generating data that may help in pushing through the betterment of the regulation for herbal supplements, especially the legislation concerning the safety of unregulated products. The data may also help in the formulation policies regarding the production of herbal supplements in the pharmaceutical industry.

1.6. Scope and Limitations

The study will focus only on ten popular herbal supplements sold in Manila. The study will only detect and quantify cadmium and chromium.

2. Methodology

2.1. Study Design

The determination of toxicants in ten popular herbal supplements in Manila is an experimental descriptive study utilizing ten herbal supplements as its sample. The samples were analysed for their cadmium and chromium contents using quantitative methods.

2.2. Sample Collection and Sample Preparation [13]

Ten most popular brands of herbal supplements were acquired from drugstores located along Taft Avenue, Malate, Manila.Five grams of the solid samples were digested in 10mL concentrated nitric acid in an open glass container overnight, at room temperature, and the next day at 80 C for 5 hours. The samples were then cooled to room temperature and then analysed using flameless atomic absorption spectroscopy.

3. Results and Discussion

Chronic exposure to Cadmium affects the kidney, lungs, and bone. In kidney, chronic exposure is implicated in the development of cancer. In lungs, long-term inhalation results in decreased lung friction and emphysema. Even if absorption by ingestion is low, chronic exposure to high levels of Cadmium in food has caused bone disorders, including osteoporosis and osteomalacia. Other consequences of Cadmium exposure are anemia, yellow discoloration of the teeth, rhinitis, occasional ulceration of the nasal septum, damage to the olfactory nerve, and loss of the sense of smell (anosmia).Itai-itai (ouch-ouch) another disease said to be caused by cadmium is characterized by severe anthralgia and osteomalacia in middle-aged, postmenopausal women with low calcium and vitamin D. Liver is the primary target in acute Cadmium exposure. Investigations have revealed hepatocellular necrosis with infiltration by inflammatory cells. Although the underlying mechanism of Cadmium toxicity has not been elucidated, possible factors include oxidative stress or lipid peroxidation of cell membranes. Unfortunately, an effective chelator for this element has not yet been discovered [9,10].

Chromium is an essential trace element required for the maintenance of normal glucose tolerance. The recommended dietary intake of chromium (III) is 50 to 200 ug/day. Normal levels in the body ranges from 0 to 10 ug/L. Since Cr(III) is poorly absorbed by any route, the toxicity of chromium is mainly attributable to the Cr(VI) form. It can be absorbed by the lung and gastrointestinal tract, and even to a certain extent by intact skin.The reduction of Cr(VI) is considered to serve as a detoxification process when it occurs at a distance from the target site for toxic or genotoxic effect while reduction of Cr(VI) may serve to activate chromium toxicity if it takes place in or near the cell nucleus of target organs. Acute poisoning is likely to occur through the oral route, whereas chronic poisoning is mainly from inhalation or skin contact. Oral intake of Cr(VI) compound may cause intense gastrointestinal irritation or ulceration and corrosion, epigastric pain, nausea, vomiting, diarrhea, vertigo, fever, muscle cramps, hemorrhagic diathesis, toxic nephritis, renal failure, intravascular hemolysis, circulatory collapse, liver damage, acute multisystem organ failure, and coma, and even death, depending on the dose. Systemic symptoms and death have occurred after external burns, with a delay of onset of gastrointestinal symptoms of hours and days. Chromate dusts can also produce irritation of the conjunctiva and mucous membranes, nasal ulcers and perforations, keratitis, gingivitis, and periodontitis. Lung cancer is the most serious long-term effect. Apart from the carcinogenic potential, prolonged exposure can result in bronchitis, rhinitis, or sinusitis or the formation of nasal mucosal polyps. The liver and kidney are often target organs for chromate toxicity. [9, 11, 12].

The extracts were subjected to FAAS. As seen in Table 1, the results showed that the ten herbal supplements do not contain detectable amounts of cadmium. The amounts are below 0.05ppm or mg/kg, which is the instrument's sensitivity. The allowable limit set by US EPA and the FDA are 0.7mg/kg/day for an average adult man and 55ug/per person per day. However, three herbal supplements revealed detectable amounts of chromium and these are LVM DS, MV and ABH. Presence of chromium in some of the herbal supplements may be contributed to the contamination due to processing of the product. A literature stated that chromium is naturally found in Moringa oleifera which is the active ingredient of MV. This finding poses a concern since long-term use of herbal supplements containing chromium can increase the risk of chromium poisoning. The amount of chromium found in the selected herbal supplements did not exceed the

safety allowable limit of 120 mcg/day or 0.35 mg/kg/day for an average adult man [14, 15, 16]. Although the concentrations of cadmium and chromium did not exceed the allowable safe limits, caution must still be exercised especially with the use of LVM DS MV and ABH. Heavy metals are cumulative which can lead to chronic adverse effects.

Table 1: FAAS Results of the Determination of Cadmium and Chromium Content of Ten Different Herbal Supplements

Herbal Supplement (HS)	Cadmium Mean (ppm)	Chromium Mean (ppm)
Natalac	BLD at 0.0500	BLD at 0.0500
Mangosteen	BLD at 0.0500	BLD at 0.0500
Prolacta	BLD at 0.0500	BLD at 0.0500
Liveraide	BLD at 0.0500	BLD at 0.0500
Silymax	BLD at 0.0500	BLD at 0.0500
Charantia	BLD at 0.0500	BLD at 0.0500
LVM DS	BLD at 0.0500	+0.0578
MV	BLD at 0.0500	+0.0084
My Marvel Taheebo	BLD at 0.0500	BLD at 0.0500
ABH	BLD at 0.0500	+0.0296

Note: BLD means below detectable limits; (+) indicates that the heavy metal being determined is detectable.

4. Conclusions and Recommendations

It may be concluded that several of the ten herbal supplements tested contains detectable amount of chromium. The herbal supplements: MV, LVM DS and ABH that exhibited detectable amounts of chromium in the quantitative analysis did not exceed the safety allowable limit for the toxicant stated. Excessive intake of these products pose a concern to the health and safety of the individuals taking it as this may increase the risk of chromium poisoning. It is recommended to increase the number of herbal supplement samples to be analyzed to have a more comprehensive data base on these products in the market.

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