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Determination of Some Heavy Metals in Selected Spices Consumed in Kano Metropolitan

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Abstract: *Spices play a vital role in enhancing the flavor, aroma, and nutritional value of culinary preparations. Understanding the mineral contents of spices is essential to evaluate their potential contributions to a balanced diet and overall human health. This study assess the proximate composition and mineral contents of nine selected spices (viz: Fenugreek, Cardamom, White pepper, Anise, Rosemary, Coriander, Cumin, Fennel, and Allspice). The heavy metal analysis indicated the presence of iron, copper, zinc and manganese in the spices. The result further showed the range of Zn (0.19±0.006 - 0.81±0.003 mg/kg), Fe (0.70±0.056 - 4.23±0.04 mg/kg), Mn (0.17±0.004 and 4.94±0.003 mg/kg) and Cu (0.24±0.005 - 0.48±0.005 mg/kg), contents of the sampled spices. However, the heavy metals fell below the recommended dietary allowance (RDA) standards. These findings highlight the benefits of these spices in promoting human health and well-being.*

Keywords: *Iron, Copper, Zinc, Manganese and Spices.*

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Introduction

Plants are sources of a great category of bioactive chemical substances that function as biochemical and physiological agents in the body. Spices represent a class of plants with such effects (Okorafor *et al*., 2019). They are rich in aromatic compounds and have found wide applications in traditional medicine, industries, food preservation, and the improvement of sensory characteristics (Evuen *et al*., 2022). Nowadays, food professionals continually search for “new” and unique spice flavorings because of the growing global demand for authentic ethnic and cross-cultural cuisines. Consumers are also seeking natural foods and natural preservatives for healthier lifestyles and natural ways of preventing ailments. Spices are also being sought for their medicinal value, as antioxidants, and as antimicrobials (Amri *et al*., 2017; Riaz *et al*., 2021).

Traditional herbal products are heterogeneous in nature and therefore impose a number of challenges to quality control, quality assurance and the regulatory process. Most herbal products on the market today have not been subjected to drug approval process to demonstrate their safety and effectiveness. Some of them contain mercury, lead, arsenic, corticosteroids and poisonous organic substances in harmful amount (Teschke *et al*., 2021).

The adverse effects of spices include: toxicity due to overdose; contamination by other medicinal plants, such as digitalis; mistaken plants, especially in Chinese spices tea mixtures; physiological changes on bodily systems; and adverse drug interactions. The problems relevant to anesthetic practice can be broadly classified into: coagulation disorders, cardiovascular side-effects, water and electrolyte disturbances, endocrine effects, hepato- toxicity, and prolongation of the effects of anesthetic agents (Ernst, 2018).

The presence of essential metals such as copper, zinc, nickel and iron in spices are useful for the healthy growth of the body; and they play vital roles as structural and functional components of metalloproteins and enzymes in living cells (Adeola *et al*., 2020); though they seem intolerable at very high levels. Due to consumption of significant amount of spices through diets, it is important to know the metal contents in these spices. Despite the growing interest in the nutritional value of spices, there is limited information on the proximate composition and mineral content of some commonly used spices. Therefore, it is important to determine the nutritional composition and mineral content of spices to fully understand their health benefits and to ensure that they are safe for human consumption.

This study is aimed at determining some heavy metals (iron, copper, zinc and manganese) present in selected spices sold in Kano metropolitan

Materials and Methods

Sampling

Nine (9) most commonly used spices in Kano, Nigeria were selected for analysis. The spices include; All-spice, Cardamom, Coriander, White pepper, Cumin, Rosemary, Fenugreek, Fennel, and Anise, during the month of January, 2023. The samples were obtained from Tarauni Market.

Sample Preparation

The spices samples were cleaned using water to remove the soil and other materials on them. The spices samples were then oven-dried at 80ºC for 6 hours. The dried samples were then crushed using mortar and pestle which were then sieved and the process was repeated and was passed through 2mm sieve. The powder was stored in dry air-tight containers and kept in the laboratory at room temperature (25ºC) prior to further analysis.

Heavy Metal Analysis

Two gram (2.0g) of each of the powdered samples was weighed into separate 100cm^3 beakers and treated with 20cm^3 of concentrated HNO_3 which was heated on an electric hot plate at 70-90ºC for 60mins. When the digestion was completed; the content of the beaker was allowed to cool, filtered through Whatman No. 42 filter paper into a 100 cm^3 volumetric flask and made up to the mark of 100cm^3 with distilled water. The flasks were then covered and kept for analysis. Glassware used for analysis were thoroughly cleaned and all reagents used were of analytical grade by Anjorin *et al.* (2010)

Instrumentation

The spice samples were ascertained using the Atomic Absorption spectrophotometer (PerkinElmer PinAAcle 900H).

Statistical Analysis

All data were subjected to statistical analysis. The values reported as mean ± standard deviation (SD) while One-way ANOVA was used to test for differences between the various spices using statistical package for social sciences (SPSS) version 22. Post-Hoc analysis was performed using Tukey HSD. The results were considered significant at *P*-values of less than 0.05 that is at 95% confidence level ($P < 0.05$).

Results and Discussion

The results of the heavy metals of the selected spices are presented in Figures 1 to 4.

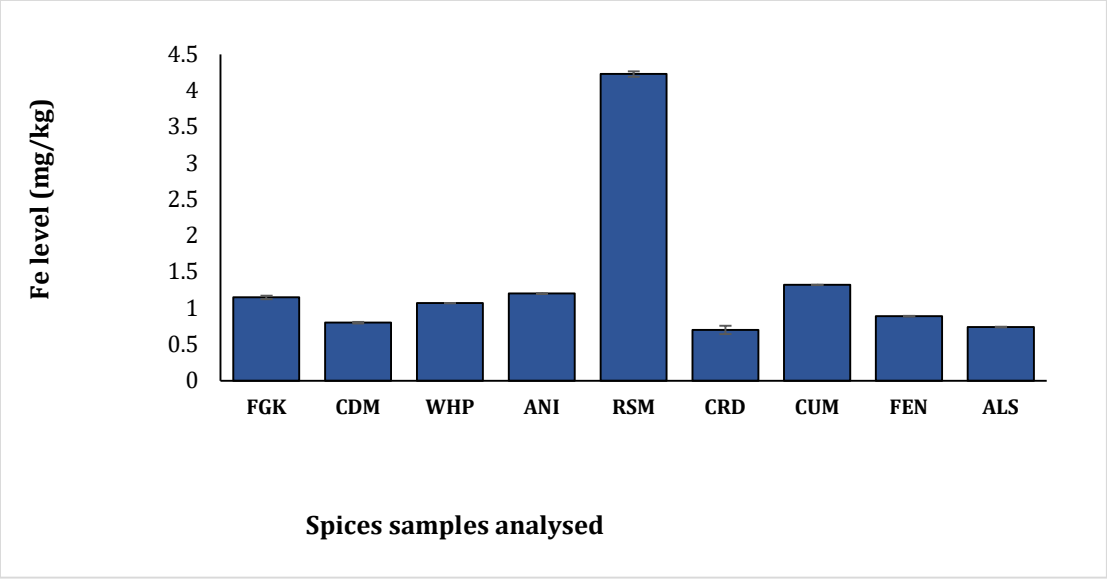

Figure 1: Iron contents of the spice samples analysed.

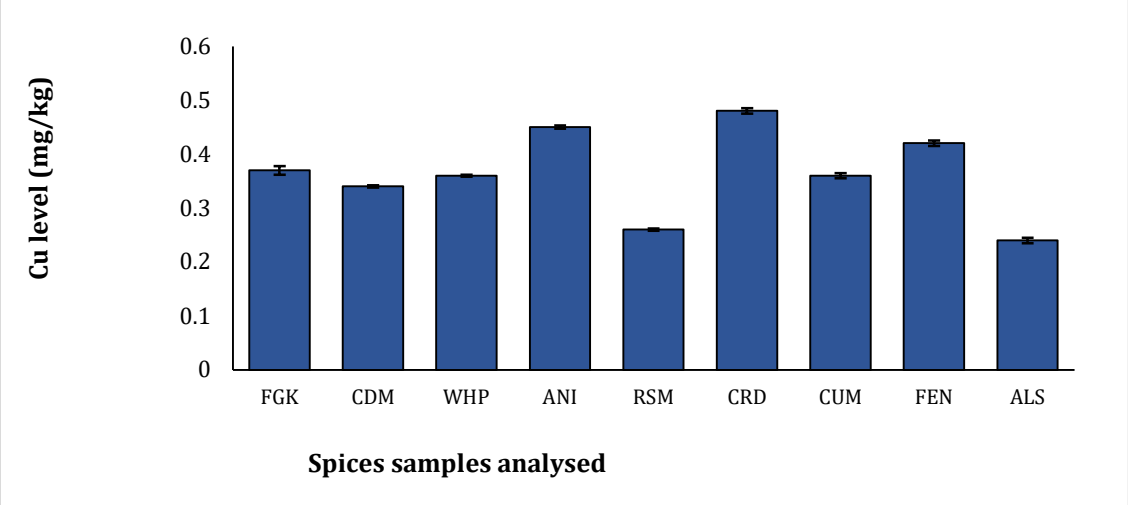

Figure 2: Copper contents of the spice samples analysed.

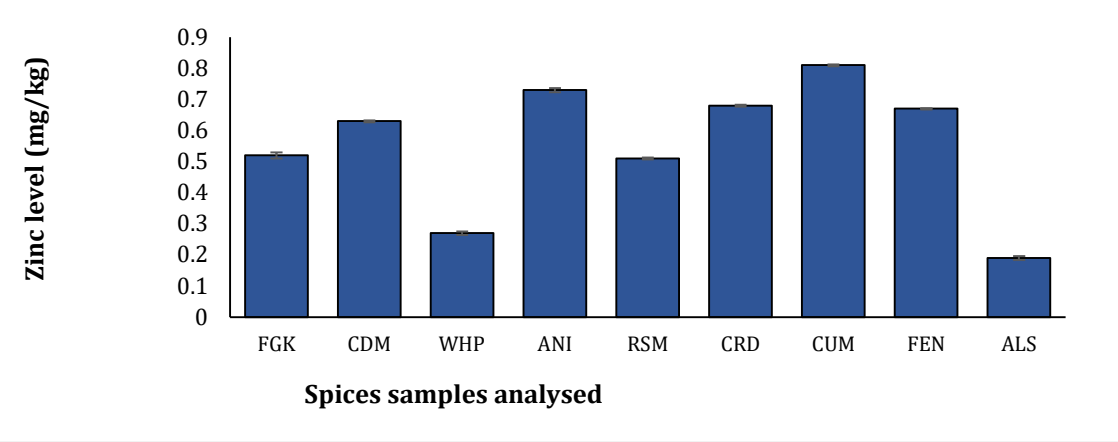

Figure 3: Zinc contents of the spice samples analysed.

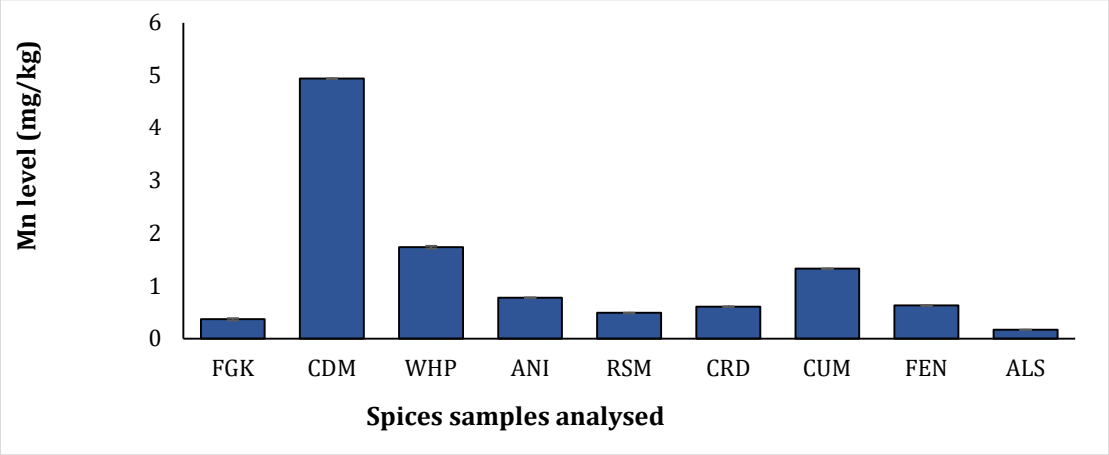

Figure 4: Manganese contents of the spice samples analysed.

Figure 1 to 4 shows the heavy metal content present in the sample spices. The result of the present study revealed that all the spices have heavy metals such as Iron (Fe), Copper (Cu), Zinc (Zn) and Manganese (Mn) at varying concentrations. The result showed that Cumin had a significant ($p < 0.05$) higher Zn level (0.81±0.003 mg/kg) compared to other spices. All spice had the lowest Zn level of 0.19±0.006 mg/L. Rosemary spice had higher Fe level of 4.23±0.04 mg/kg, followed by Cumin (1.32±0.003 mg/kg) and Anise (1.20±0.002 mg/kg). Coriander had the lowest Fe levels of 0.70±0.056 mg/kg. The results show that Cardamom and Cumin had significant ($p < 0.05$) highest levels of Mn (4.94±0.003 mg/kg) and Mg (85.72±3.16 mg/kg) respectively compared to other sampled spices. There is significant difference ($p < 0.05$) in the Cu levels across the sampled spices that ranged from 0.24±0.005 mg/kg-0.48±0.005 mg/kg. The results indicated that iron, copper, zinc and manganese contents of the sample spices are below the Recommended Dietary Allowance value (RDA) for these minerals.

The copper content of sampled spices ranged between 0.24±0.01-0.48±0.01 mg/kg, which is higher compared to 0.02 ±0.1 mg/kg found in some edible plant parts (Khan *et al*., 2013). The RDA value for copper is 0.9 mg/day for adult. Copper contributes a role in hemoglobin formation and play a role in iron and energy metabolism (FAO, 2001). The zinc content of the study samples ranged between 0.19±0.01-0.81±0.003mg/kg. This is comparable to the zinc value of 0.20±0.02 mg/kg observed by Khan *et al*. (2013). Zinc plays a vital role in gene expression, regulation of cellular growth and participates as a cofactor of many enzymes. It also plays an important role in motility of sperm during liquation and mating. The RDA of zinc is 8 to 11 mg/day for adults (FAO, 2001).

Iron content of sampled spices were in the range of 0.70±0.06-4.23±0.04 mg/kg. This is lower than 6.44±0.4 mg/kg found in other plants like *Trianthema portulacastrum* L (Khan *et al*., 2013). The RDA value of iron is 8 mg/day. These spices are good source of iron. Iron is required for hemoglobin formation and its deficiency leads to anemia (FAO, 2001). Manganese content of plant samples ranged between 0.17±0.004-4.94±0.003mg/kg. These values are lower than 9.8 to 38 mg/kg reported in some leafy vegetables and lower than 116 mg/kg in balsam apple leaves

(Khan *et al*., 2011). The RDA for manganese is 2 to 5 mg/kg. The result showed that these spices are good source to provide daily manganese. Manganese is a co-factor for many enzymes which take part in glucose and amino acid metabolism (FAO, 2001).

Conclusion

The result of this study shows that the spices – (Fenugreek, Cardamom, White pepper, Anise, Rosemary, Coriander, Cumin, Fennel and All spice) contain Fe, Cu, Zn and Mn in varying concentrations.

The result revealed that the heavy metals of the spices were below the recommended dietary allowance (RDA) FAO standard.

Recommendations

Further studies is recommended to better understand the Clinical trials should be conducted on the metals bioavailability of these spices in humans. This can provide way whereby these spices could be applied in mineral supplementation in formulating diets for vulnerable groups or diets for the management of certain non-communicable diseases.

There is need for further development of products based on these spices for households and commercial purposes to ensure food security. These in turn will increase its production and utilization, thereby making it more popular.

Authors' Contributions

Dagari M.S.: Conceptualization and design of the research work
Khadija K. : Undertaking the research work, write-up and data analysis.
Mohammed, M. I.: Supervision and Editing of the write-up
Kanada, Y.B: Assisted in editing and formatting the manuscript

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