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Concentration of heavy metals in some selected cereals sourced within Kaduna state, Nigeria.

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Abstract: *Concentrations of heavy metals were assessed in rice, maize, millet, guinea corn and wheat sourced randomly within Kaduna metropolis, Kaduna state, Nigeria. The samples were crushed, sieved, and digested and the samples were then analyzed using atomic absorption spectrophotometer. The result showed that the concentration of Copper(Cu) in the samples analyzed was 1.58mg/kg, 0.98mg/kg, 5.23mg/kg, 0.90mg/kg, and 2.41mg/kg while Zinc(Zn) was 0.70mg/kg, 2.01mg/kg, 4.51mg/kg, 2.04mg/kg, and 11.32mg/kg, and Iron(Fe) was 8.24mg/kg, 5.99mg/kg, 10.54mg/kg, 18.97mg/kg, and 13.61mg/kg, for rice, maize, millet, guinea corn, and wheat respectively. However, cadmium was not detected in any of the cereal samples. The levels of heavy metals determined in the analyzed cereal samples were found to be below the permissible limit set by FAO/WHO; hence, the concentration of these heavy metals in the selected cereals analyzed, may not presently pose a health hazard in the population and can as well serve as good and dependable sources of essential trace metals to the human population.*

Keywords:*Atomic Absorption Spectrophotometer, Cereals, Heavy Metals, Kaduna state*

I. Introduction

Cereals are a major source of nutrients in northern Nigeria, and are also the most commonly consumed foods in the region; cereals are grown and distributed to all parts of the country through retails, and serve as dependable source of energy and minerals to humans in particular [1]. They are rich in Carbohydrate, trace elements, vitamins, oil and protein [2]. However, cereal protein is low in lysine [3], [4]. Food safety simply means absence or presence of safe levels of contaminants, adulterants, naturally occurring toxins or any other substance that may make food injurious to health on an acute or chronic basis. Food quality can be considered as a complex characteristic of food that determines its value or acceptability by consumers. Metal accumulation in plant depends on plant species, genetics, types of soil and metal, soil conditions, weather, environment, stage of maturity and supply route to the market[5], [6], [7], [8].

Heavy metals are environmental contaminants capable of causing human health problems if excess amount is ingested through food [9], heavy metals are non biodegradable and persistent, have a long biological half lives and can be bio-accumulated through biological chains [9]. Heavy metal toxicity may occur due to contamination of irrigation water, the application of fertilizer and metal based pesticides, industrial emission, harvesting process, transportation, storage or sale. Crops and vegetables grown in soils contaminated with heavy metals have greater accumulation than those grown in uncontaminated soils [10]. This is because farmlands situated in industrialized areas are prone to pollution by the release of chemicals into the farmlands leading to contamination of plant crops [11].

Elements such as Cadmium (Cd), Chromium (Cr), and as are considered carcinogenic while Iron (Fe), Copper (Cu), Manganese (Mn), Zinc (Zn) and Nickel (Ni) are considered essential trace elements. The intake of heavy metal-contaminated cereal crops may pose a risk to human health[12], [7].Trace elements do not provide calorie but they play an important role in the metabolic regulations of the human body if present in required amounts. For example, they are co-enzymes and co-factors in human system which plays different roles in growth, metabolism and immune system development, [7]. However if the levels of these essential elements are above the acceptable limits, they become harmful to our health [13]. Lead toxicity in the body can cause musculoskeletal, renal, ocular and immunological and reproductive effects [14]. Heavy metal contamination of food is of great importance to note when plants are grown on or near contaminated areas. Metal analysis of foods is a very important aspect of food quality control, [12], [7].

Due to the importance and attendant danger posed by these metals to humans coupled with an increase in environmental pollution, it is important to assess the quality food items periodically in this region through metal analysis. The assessment will create public awareness on the relevant dangers associated with intake of

food containing huge amount of heavy metals give an insight on the level of metal contamination and by extension the impact on food safety standard and risk to consumers.

II. Materials And Method

2.1 Sampling

A total of 10 samples, 2 samples per cereal, (Rice, Maize, Guinea corn, Millet and Wheat) were randomly collected from Kaduna central market, Kaduna metropolis, in Kaduna State, Nigeria. Samples were sun dried until properly dry. A porcelain pestle and mortar was used to grind the soft samples while a wooden pestle and mortar was employed in the milling of the hard samples. A suitable sieve was used for sieving the samples. A composite sample was obtained from a combination of each sample type before grinding. The powdered samples were stored in HDPE sample bottles prior to wet digestion. The samples were chosen due to their wide acceptability and consumption in the region.

2.2 Reagents

All reagents were of Analytical grade from the Chemistry laboratory, Nigerian Institute of Leather and Science Technology, Samaru, Zaria, Kaduna state, Nigeria.

2.3 Procedure

2.3.1 Digestion

2.5 g of the sample, previously dried to constant weight was placed in 100 mL reflux flask. 15 mL of concentrated HNO_3 and 5 mL of concentrated H_2O_2 were mixed with the sample. The mixture was allowed to stand for about 48 hrs at room temperature. It was then refluxed on a heating mantle at 90°C until brown fumes ceased to evolve, 4-6 hrs and allowed to cool. 5 mL of 60% (v/v) $HClO_4$ was added to the mixture and further refluxed for 30 min. The digest was allowed to cool to room temperature. It was filtered into a 100 mL volumetric flask with a Whatman's No. 42 filter paper and made to the mark with de-ionized water. This was repeated for all the samples in triplicate. A blank was also prepared similarly [1].

2.3.2 Analysis

The digests were analyzed for their content of Fe, Cr, Cu, and Zn with the aid of an Atomic Absorption Spectrophotometer at the Multi User Research Laboratory, Ahmadu Bello University, Zaria, Nigeria The acetylene gas pressure and flow rate as well as burner positioning were automated. The instrument was allowed to warm for 30 min before analysis.

III. Results And Discussion

3.1 TABLE 1: Concentration (mg/kg), of Metals in Cereals Selected from Kaduna Central Market, Kaduna State, Nigeria.

Metal	Cereal samples (mg/kg)					FAO/WHO
	Rice	Maize	Millet	Guinea corn	Wheat	Safe limit(mg/kg)
Cu	1.58	0.98	5.23	0.90	2.41	73.3
Fe	8.24	5.99	10.54	18.97	13.61	425.5
Zn	0.70	2.01	4.51	2.04	11.32	99.4
Cd	ND	ND	ND	ND	ND	0.2

The result of the analysis of heavy metals in some selected cereals is presented in Table 1. This result showed a variation in the concentration of metals analyzed in all samples. The results have shown that Iron (Fe) has the higher concentration over other metals analyzed. Cadmium (Cd) was not detected in any of the cereal samples analyzed in the study. Also Guinea corn and Millet have the highest concentration of these heavy metals than the other cereal samples listed above except for Copper (Cu), which was high in Millet and wheat than the other cereal samples. The levels of heavy metals determined in the analyzed cereal samples were found to be below the permissible limit set by [15].

The results obtained in the current study in the selected cereals are in agreement with [16], [17], who reported similar range of values of these metals in the cereals analyzed. Also, results obtained in the current study on Zinc (Zn) and Iron (Fe) is in agreement with [18], who also reported similar range of values of these metals in the cereals analyzed. The results indicated shows that these selected cereals contain substantial amount of these trace metals and can serve as reliable source of trace metals in both humans and animals.

However, the results obtained in this study differ from similar work carried out by [1], [19], who reported lower values of these heavy metals in cereals than the one obtained in this work. Also, the result of this present study disagrees with the work of [20],who reported higher values of heavy metals in cereals than the one

obtained in this work, The difference may be due to heavy metal accumulation in plant which depends on plant species, genetics, types of soil and metal, soil conditions, weather, environment, stage of maturity and supply route to the market, as reported by [7], [8]. Also, the difference in concentration of heavy metals reported in this study compared to other related studies could be as a result of differences in geographical location of the cereals, Farmlands situated in industrialized areas are prone to pollution by the release of chemicals into the farmlands leading to contamination of plant crops [11].

The variation of this work with other similar works could also be as a result of heavy metal toxicity. Heavy metal toxicity may occur due to contamination of irrigation water, the application of fertilizer and metal based pesticides, industrial emission, harvesting process, transportation, storage or sale [10].

Therefore, the concentration of these heavy metals in the selected cereals analyzed may not presently pose a health hazard in the population and can as well serve as good and dependable sources of essential trace metals to the human population.

IV. Conclusion

After the analysis, the selected cereals were found to have heavy metals; Copper (Cu), Zinc (Zn), and Iron (Fe) in each of the samples. Cadmium (Cd) was not present in all the cereals analyzed. However, the concentrations of these metals in the cereals analyzed were below the safe limit set by [15]. Therefore, these cereal samples should be considered safe for consumption and may as well serve as sources of trace metals to the population.

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