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Heavy Metal Contamination of Pleurotus Tuberregium Sclerotia (Osu) Consumed in Enugu, South East Nigeria

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ABSTRACT: Heavy metal contamination of food is a global public health problem especially in developing countries. The WHO 2015 report on global burden of food contamination stated that an estimated 600 million people are affected resulting in 420,000 deaths annually with children under 5 years of age constituting 40% of burden and 125,000 deaths annually.The present study was aimed at determining the concentrations of Nickel (Ni), Cadmium (Cd), Lead (Pb) and Chromium (Cr) in some samples of wild type pleurotus tuberregium sclerotia consumed in Enugu, Southeast Nigeria. Heavy metal concentrations were determined using Atomic Absorption Spectrometer (AAS 240FS) Varian, Varian Inc, Japan. The range for concentration of Nickel was (3.29±0.63-3.67±0.00), Cd (0.002±0.01-0.005±0.0), Pb(0.04±0.03)-0.07±0.02) and Cr(0.46±0.26-1.0±0.62),ppm respectively. These are within the WHO tolerable concentrations of Ni, Cd, Pb and Cr in food.These findings shows that pleurotus tuberregium sclerotia consumed in Enugu has lower concentrations of heavy metals compared to the WHO recommended values.
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Key Words: Pleurotus tuberregium sclerotia, Heavy metals, Enugu, Health

INTRODUCTION

Pleurotus tuberregium commonly known as the king tuber mushroom is an edible mushroom that produces underground tubers (compact mass of mycelium) known as the sclerotia and Osu in the general Igbo language of south east Nigeria. It belongs to the family pleurotaceae which are found in the tropical and sub-tropical regions of the world (Ezea *et al.*, 2021).The sclerotia which is a common unprocessed farm harvest used as soup thickener or traditional medicine for various ailments has been shown to accumulate great concentrations of heavy metals (Uloma *et al.*, 2018). This is possible due to the decomposition of soil complex substrates such as organic matter into simpler ions by enzymes produced by the sclerotia of pleurotus tuberregium (Adumanya *et al.*, 2022). In Nigeria, several cases of food poisoning linked to heavy metal contamination have been reported (Bayo *et al.*, 2021). Knowledge of the heavy metal contamination of the wild type pleurotus tuberregium sclerotia consumed in Enugu is limited. This study was therefore undertaken to determine the concentrations of some heavy metals (Ni, Cd, Pb, and Cr) in some wild type samples of pleurotus tuberregium sclerotia consumed in Enugu, south east Nigeria.

MATERIALS AND METHODS

Area of Study

The study was carried out in Enugu State, southeast Nigeria. The State takes its name from its capital and largest city, Enugu. It has an area of 7,161km^2 with a population of 3,267,837 comprising mainly the Igbo tribe of the south eastern Nigeria. It lies between longitudes 6^o 30 'E and 6^o 55 'E and latitudes 5^o 15 'N and 7^o 15 'N. It consists of three senatorial divisions namely Enugu East, Enugu North and Enugu West (Ndulue *et al.*, 2021).

Collection of Samples

Enugu State formed the sample frame and was stratified into three (3) zones along the senatorial divisions. Three (3) samples of pleurotus tuberregium sclerotia were randomly collected from each of the senatorial zones making a total of Nine (9) samples from the following markets: Enugu East senatorial zone – Ekeotu Amaechi, Eke Eha-Amufu and Eke

Agbani Markets; Enugu North senatorial zone – Eke Obollo, Nkwo Ibagwa and Eke Enugu Ezike markets; Enugu West senatorial zone – Eke Mgbowo, Orie Akama and Nkwo Ebe markets. The samples were authenticated by the taxonomist Dr. C. C. Onyeneke of the Department of Botany, University of Nigeria, Enugu State, Nigeria.

Digestion of Samples

The dry sample digestion method according to Onah *et al.,* (2019) was performed at the springboard Research Laboratory Awka Anambra State, Nigeria. Samples were grinded with Thomas Whitney Milling Machine and 2g of the powdered sample was added into a 100ml conical flask and 30ml of digestion solution known as Aquaregia mixture containing 20ml of 20% high purity HNO_3 and 10ml of HCI were added to it. The mixture was heated to ashing in a thermostatically controlled Murfle Furnace until a clear digest was achieved at 80ºC at 3 hours. Thereafter, the ash was allowed to cool at room temperature then transferred to sample bottles and made up to 50ml with distilled water for metal analysis.

Heavy Metal Analysis

Heavy metal content of the pleurotus tuberregium sclerotia digest was performed at the Springboard Research Laboratories Awka, Anambra State, Nigeria using the Atomic Absorption Spectrometer (AAS 240FS) Varian, Varian Incorporated, Japan. A stock standard solution containing 100mg/L in 2% HNO of the metal (Ni, Cd, Pb and Cr) was prepared. A calibration blank was prepared and a calibration curve plotted by using the absorbance of standard against their concentrations. When the samples are aspirated into the flame and atomized, the AAS light beam is directed through the flame into monochromatic light absorbed wavelength. A source lamp composed of the specific element for determination was applied (hollow cathode lamp), making the method relatively free from spectral interferences. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the metal in the sample.

RESULTS

The results of the study was expressed in table 1. Nickel, Cadmium, Lead and Chromium were all detected in all the samples of pleurotus tuberregium sclerotia used for the study. The mean values of the metals in the samples collected from the different senatorial zones were lower than the WHO maximum permissible limit for the metals in food.

Table 1: Concentrations of some heavy metals in the samples of pleurotus tuberregium sclerotia

Heavy metal (PPM)	Enugu West	Enugu East	Enugu North	WHO Permissible Limit (PPM)(Kinuthia et al, 2020)
Nickel	3.29±0.63	3.67±0.00	3.66±0.01	10
Cadmium	0.005±0.04	0.005±0.03	0.002±0.01	0.02
Lead	0.04±0.03	0.05±0.04	0.07±0.02	0.1-0.3
Chromium	0.62±0.71	1.0±0.62	0.46±0.26	1.3

Values are expressed as means ±SEM for three measurements, unit of measurement (parts per million, PPM; 1PPM = 1mg/L = 0.001ug/L, Detection limit = 0.001PPM

DISCUSSION

The consumption of unprocessed pleurotus tuberregium sclerotia either as food or traditional medicine is a common practice in Nigeria. Nickel, cadmium, Lead and Chromium were detected in all the samples of pleurotus tuberregium sclerotia analysed. The presence of heavy metals in food is a major threat to human health because heavy metals are non-biodegradable, bioaccumulate and can induce harmful alterations in the physiological processes of the body even in trace amounts especially at a chronic consumption of contaminated food (Isiuku and Enyoh, 2020, Adumanya *et al.,* 2022). The University of Port Harcourt Teaching Hospital (UPTH) cancer registry (2009-2013) reported the prevalence of cancer among

the Nigerian people which has been also linked to heavy metal contamination (Bayo *et al.*, 2021).

The concentrations of the heavy metals (Ni, Cd, Pb and Cr) obtained from the present study were within the permissible limits when compared to their WHO permissible limits in food, thus pleurotus tuberregium sclerotia are suitable for consumption for the communities within Enugu. This agrees with the findings of Nnorom *et al.*, (2013) and Uloma *et al*., (2018) who reported lower concentrations of these metals compared to their WHO permissible limits suggesting that the consumption of the sclerotia of pleurotus tuberregium poses no toxicological risk to health.

However, our present finding does not agree with the findings of Okwulehie and Ogoke (2013) who reported higher concentrations of cadmium (0.86ppm) and Lead (0.66ppm) compared to their WHO maximum permissible limits of 0.02ppm and 0.1-0.3ppm respectively. Cadmium and Lead are among the 10 most harmful heavy metals in the WHO global burden of food contamination list (Kinuthia *et al.*, 2020; Adumumanya *et al.*, 2022).

CONCLUSION

The results of the present study suggests that pleurotus tuberregium sclerotia harvest from within Enugu State, South east Nigeria are suitable for consumption. However, considering the possible health outcomes due to presence and bioaccumulation of Ni, Cd, Pb and Cr that may result from a life-long consumption, it is recommended that pleurotus tuberregium sclerotia should be processed (demetalised) before consumption.

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