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STUDY ON THE DEGREE OF EXPOSURE OF TAPIOCA (LOCAL CASSAVA CONDIMENT) TO SOME HEAVY METALS DURING DRYING

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ABSTRACT

A local cassava condiment; tapioca, was collected along major highway roads in Enugu-State. The samples were digested with in a 1 : 2 : 3 mixture of H_2SO_4, $HClO_4$ and HNO_3 and analysed for lead, zinc, cadmium and iron with an Atomic Absorption Spectrophotometry (AAS) equipped with air-acetylene flame. Results showed that the ranges of the mean concentration of the metals were: Pb (0.65-7.25 mg/Kg), Cd (0.01-0.09 mg/Kg), Zn (0.06-4.95 mg/Kg) and Fe (0.64-6.25 mg/Kg). The results also show that the levels of lead was high compared to zinc, cadmium and iron. The concentration of lead in the sample collected along the highway was significantly different ($P < 0.05$) from the control sample. It was concluded that the samples collected from the highway roads were polluted with lead as a result of vehicular activities.

Key words: Vehicular emissions, Heavy metals, Tapioca, Sun drying.

INTRODUCTION

Cassava *(Manihot spp)* is a perennial woody shrub, which grows in the tropical and subtropical areas of the world. It originated from the Amazon basin of tropical Brazil and was introduced into West Africa by the Portuguese[1]. Cassava became generally accepted and fully integrated into the farming systems of Southern Nigeria about 150 years ago, even though it was introduced into Nigeria over 300 years ago[2]. Garri flour derived from cassava is a major staple food for many people in most African and Latin American countries. Garri is the most popular form in which cassava is consumed in Nigeria. However there are other cassava products other than Garri which include tapioca, foufou and sun-dried cassava

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(lafun). Tapioca is a word derived from the tupi language of Brazil (tipioka), meaning juice of cassava. Tapioca is essentially produced from starchy ingredient, produced from treated and sun-dried cassava. It is processed into either fine dried flake more commonly small hard white spheres, pearls or chips. Tapioca starch is commonly used as a food thickener and it is also used as a binder in pharmaceutical tablets and natural paints. It is also regarded as one of the excellent sources of carbohydrate hence it supports growth and maintenance. The common method of drying tapioca is by direct sun-drying. However the practice in most part of the country is to dry tapioca along major highway roads where heat of the sun is more felt. Considering the heavy traffic of vehicles along the highway roads it is easily possible for this cassava product to be exposed to injurious chemicals which are prevalent in vehicle emissions. It is against this background that we have undertaken, in the present study the analysis of sun-dried tapioca for some heavy metals.

EXPERIMENTAL

Materials and methods

Sampling: Samples of tapioca were collected from different locations along Enugu state highway roads. These include Ugwu-Oba, Oji-river, Umanna, Obele-Agu. Enugu-Ngwo. Control samples were collected from the local settlement of Owere-Ezeorba where limited exposure to contaminants is envisaged.

Sample preparation

The tapioca samples were further dried to a constant weight at 105^0C. The dry samples were ground using plastic mortar and pestle and thereafter stored in desiccators. Wet digestion of samples was done according to method reported in literature[3,4]. 10.00 g ground samples were digested in a mixture of H_2SO_4, $HClO_4$ and HNO_3 in a ratio of 1 : 2 : 3, respectively. The resultant solution was diluted appropriately. Working standards of all metals to be determined where prepared from certified AAS stock standards. The solutions were aspirated in an Atomic Absorption spectrometer, UNICAM, 969. Sample blank prepared by taking 40ml of the digestion mixture through the digestion procedure were analysed for the all metals.

Statistical analyses

The various data obtained were subjected to statistical analysis mean, standard deviation and one-way analysis of variance (ANOVA), according to method reported elsewhere[5]. Significantly different means were separated according to the method of Duncan[6].

RESULTS AND DISCUSSION

The results of lead, cadmium, zinc and iron concentrations in the various tapioca samples as determined by Atomic Absorption spectroscopy (AAS) are shown in Table 1. Results show that Pb accumulation in tapioca samples collected from Obele-Agu (B), Enugu-Ngwo, Obele-Agu(A), and Umanna were significantly ($P < 0.05$) higher than values obtained form the control tapioca samples and Ugwu-oba (A). Cd values of 6.09 ± 0.002, 0.07 ± 0.002, 0.07 ± 0.001 were obtained from tapioca samples collected from Enugu.Ngwo, Obele-Agu (B), Obele-Agu (A) respectively. These values were significantly ($P < 0.05$) higher than the values of 0.01 ± 0.001, 0.002, 0.03 ± 005, 0.03 ± 0.0001, 0.04 ± 0.003 and 0.005 ± 0.004 observed in tapioca samples collected form the Owerre Ezeorba (control), Oji-River (A), Ugwu-Oba (A), Umanna, Ugwu-oba (B) and Oji-River (B) respectively. Zn values of 4.95 ± 0.103, 4.49 ± 0.082 and 4.95 ± 0.090 observed in tapioca samples from Oji-River (A), Umanna and Obele-Agu (A) were significantly ($P < 0.05$) higher than Zn values recorded in tapioca samples from the other locations. Tapioca samples collected from Umanna, Obele-Agu (B), Owerre Ezeorba (control), Ugwu-oba (B) and Enugu-Ngwo had significantly ($P < 0.05$) higher Zn values of 6.25 ± 0.151, 6.19 ± 0.121, 6.19 ± 0.080, 5.49 ± 0.191 and 5.55 ± 0.185 which differed from the Zn values of tapioca samples collected from other location. It is observed that some of these locations apart from being on the major dual carriage express way from Enugu-Onitsha, have parking bays where most of the heavy trucks have one reason or the other to stop.

Table 1: Mean concentration of heavy metals (mg/Kg) in the tapioca samples

Metals	Ugwu-Oba (A)	Oji-river (A)	Umanna	Ugwu-Oba (B)	Oji-river (B)	Obele-Agu (A)	Enugu-Ngwo	Obele-Agu (B)	Control
Pb	0.65^{c} ± 0.07	3.40^{b} ± 0.10	5.17^{a} ± 0.15	4.99^{b} ± 0.17	2.44^{b} ± 0.19	6.17^{a} ± 0.20	7.22^{a} ± 0.20	7.25^{a} ± 0.20	0.36^{c} ± 0.091
Cd	0.03^{b} ± 0.01	0.01^{c} ± 0.00	0.03^{b} ± 0.00	0.04^{b} ± 0.00	0.05^{b} ± 0.00	0.07^{a} ± 0.00	0.09^{a} ± 0.00	0.07^{a} ± 0.00	0.01^{c} ± 0.001
Zn	0.06^{c} ± 0.05	4.95^{a} ± 0.10	4.49^{a} ± 0.08	3.97^{b} ± 0.0	3.46^{b} ± 0.08	4.95^{a} ± 0.09	3.46^{b} ± 0.012	2.92^{b} ± 0.15	0.10^{c} ± 0.001
Fe	0.64^{c} ± 0.06	2.75^{b}. ± 0.12	6.25^{a} ± 0.15	5.49^{a} ± 0.191	4.86^{b} ± 0.19	4.95^{b} ± 0.19	5.55^{a} ± 0.19	6.19^{a} ± 0.12	6.19^{a} ± 0.080

^{abc}Row means with different superscript are significantly different ($P < 0.05$)

(A) Right lane of the Enugu-Onitsha dual carriage express road.

(B) Left lane of the Enugu-Onitsha dual carriage express road

The emission from these trucks and other cars that stop to transact one business or the other at the parking bays may account for the very high Pb content of tapioca samples collected from such locations as Obele-Agu (B), Enugu-Ngwo and Obele-Agu (A). Dust due to vehicular movement, exhaust emissions and tyre wear emission have more serious impact on air-borne Pb levels. Automobile emission had been considered as one of the most important source of air-borne lead in Nigeria in the 1990's. The lead content of petrol used in Nigeria then was in the range of 0.4-0.8g/L[7,8]. Studies had shown that roadside soils usually contain higher lead values[9,10]. Many countries have banned the use of leaded petrol. The International Fuel Quality Centre has reported that there is no longer leaded gasoline in sale in Nigeria[11], this report has not been verified by checking the ambient levels of lead in Nigerian highways. Moreover, Ugwu et al.[12] reported very high enrichment factors for lead in fermented cassava meal dried along Lokoja-Abuja high as compared to samples dried under ambient atmospheric condition and in the oven. Thus, this study and other reports[10,11] is an indication that vehicle emissions might contain lead, which is the likely reason for the relatively high levels of Pb in some of the samples.

It is also worthy to note that tapioca samples form the control location had significantly low Pb content. These samples were dried at a location that is very distant from heavy vehicular emissions. The concentrations (mg/Kg) of lead recorded for tapioca samples from all location except Ugwu-Oba (A) and Owerre-Ezeorba were above the MAFF and the Australian National Health and Medical Research Council recommended limits of 2.0 mg/Kg[13].

The Cd levels of samples collected from Obele-Agu(A), Enugu-Ngwo and Obele-Agu (B) were above the Codex Committee of Food Additives and Contaminants draft guideline of 0.05 mg Cd/Kg[14]. However the levels of Cd for all samples were below the Australian National Health and Medical Research Council recommended limits of 2.0 mg/Kg.

Long term exposure or consumption of food exposed to vehicular emissions could be detrimental to health due to chronic intoxication. Lead is a cumulative poison and poses the greatest problem of chronic intoxication. Lead has comparatively high affinity for proteins; ingested lead ions bind with the haemoglobin and plasma protein of the blood. This leads to inhibition of the synthesis of red blood cells and thus the vital transport of oxygen. If the binding capacity of the substrate is exceeded, lead passes into the bone marrow, liver, and kidney[15]. Cadmium is also a cumulative toxicant that affects the kidney, bone metabolism and the reproductive tracts, and it is also carcinogenic and an endocrine disruptor[16].

CONCLUSION

The practical importance of this findings is that tapioca traders must be compelled to stop exposing their tapioca's to roadsides with high vehicular traffics as this exposes the food to contamination. Public health officers should safe the ignorant tapioca consumers in Nigeria the potential hazards of taking tapioca from such locations. Also tapioca traders who display their products along the highway roads should be advised to cover the tapioca with cellophane materials, which will not allow emissions to settle on the tapioca.

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