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# ASSESSMENT OF PESTICIDE AND HEAVY METAL RESIDUE IN TWO VARIETIES OF BEANS SEED FROM AGO – IWOYE MARKET, OGUN STATE, NIGERIA.

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## ABSTRACT

***Beans (Phaseolus Vulgaris) are one of the staple foods in Nigeria, in order to ensure food safety, foreign matter, and contaminants need to be monitored to be within the acceptable safe limit. Two varieties that are mostly consumed- Honey beans (Oloyin) and Brown beans (Olotu) were obtained from Ago-Iwoye market, Ogun state, southwest Nigeria. Heavy metals and Organochlorine pesticide analyses were carried out on them. The concentration of Pb and Cd ranged from BDL to 0.060 mg/kg and 0.010 to 0.040 mg/kg respectively, which is within the safe limit. However, it was observed that Fe content in Olotu beans was 0.278 mg/kg which is higher than the acceptable safe limit. Organochlorine Pesticides residue indicates the presence of Endrin Ketone with 15.740 mg/kg and 19.820 mg/kg and o,p '-DDT range of BDL – 0.030 mg/kg for both beans respectively.***

**Keywords:** *Beans; Heavy metals; Organochlorine; Pesticides residue; Health Implication*

## INTRODUCTION

Food safety is one of the important factors that determine a nation's economic growth and sustainability. Farm produce consume as food, either on the farm or during storage, is exposed to attack by insect pests and diseases. Insect pests are very destructive and greatly multiply within a short period of invasion causing up to 100 % loss if necessary measures are not taken. In order to overcome this challenge, farmers have adopted the application of pesticide on their produces either on the farm or in storage (Ssekandi, *et al.,* 2016). Pesticides are chemical substances capable of destroying pests or controlling their growth and reproduction (Ogunfowokan*et al.,* 2012). These are usually indiscriminately used by both ignorant farmers and sellers of farm produce to protect their crops against destructive pests (Olutona and Aderemi., 2019). The unregulated overuse of pesticides has led to the accumulation of the residues of these chemicals in the productwhich when consumed by animals or humans have been found to cause deadly diseases including; cancers, congenital malformations, neurotoxic disorders, and infertility (Olufade*et al.,* 2014). One of the commonly contaminated food crops is 'Beans', with the most common pest that reduce the yield and income of beans farming is the bean fly, (*Ophiomyia spp.)* (Ssekandi, *et al.,* 2016)

The effect of residual pesticides on food safety is of great concern as they are Persistent Organic Pollutants (POPs) that are largely released to the environment by urbanization, industrialization, use of agricultural fertilizers or pesticides to preserve food (Dundar, 2004; ASTDR, 2015). Contamination of food by POPs is a significant health problem because they can accumulate and magnify through the food chains, which later pose a threat to human

health (Binelli and Provini, 2004). Organochlorine pesticides (OCPs) are widely used by Nigerian farmers due to their high efficacy and low cost although, their use has been banned (Ogunfowokan *et al*., 2012). The presence of OCPs has been reported in cocoa beans (Oyekunle *et al*., 2017 and bean seeds and dried yam chips, and other farm produce (Olufade *et al*., 2014).

Apart from pesticides, another hazardous contaminant commonly found in food is heavy metals. The presence of these in the environment has been associated with discharges from urban centers, waste, and sewage leakages into rivers as well as entry of various agricultural chemicals, petroleum products, and domestic wastes into rivers and canals (M'onica *et al*., 2006). Heavy metals are non-biodegradable and persistent in the environment (Haware and Pramond, 2011). Food toxicity by heavy metals can result from contamination of irrigation water, the application of fertilizer and metal-based pesticides, industrial and vehicular emission, harvesting process, transportation, storage, or sale (Ladigbolul and Balogun, 2011).The deposition of Pesticides and heavy metals on crops' foliar surfaces may occur during production, transportation, and marketing (Jassir*et al*., 2005). These contaminants may cause various damages to the kidneys, cardiovascular, immune, hematopoietic, central nervous and reproductive systems (FSA, 2007; Hezbullah *et al.,* 2017).

Determination of the concentration of pesticide residues in food is a way to monitor the level of human exposure to these hazardous chemicals before the manifestation of deleterious health effects. Hence, the objective of this study is to provide baseline information on the levels of pesticide and heavy metal residue in two major varieties of bean seeds sold in Ago –Iwoye market, Ogun state, Nigeria. (Honey beans and Brown beans respectively).

## MATERIAL AND METHOD

### Study Area

The two most commonly consumed varieties of bean seeds Brown beans (popularly called *Olotu*) and Honey beans (popularly called *Oloyin*) were selected for this study. These were purchased from a popular local food market in Ago – Iwoye, situated in Ijebu North, Ogun state, Nigeria, with geographical coordinates of 6° 57' 0" North, 3° 55' 0" East. One of the foremost state Universities in Nigeria is established in this town, the market also enjoys patronageby people from neighboringtowns and states like Ibadan, Ijebu-Ode, and Ondo all in South-West, Nigeria.

### Collection and Pretreatment of Samples

About 200g of each of the selected bean varieties were randomly purchased from five different sales outlets. The samples were collected in labeled glass bottles, taken to the laboratory, and stored in the refrigerator at 4$^{o}$C before analysis. Healthy beans seeds samples were handpicked leaving behind bruised and insect-infested bean seeds. Also, foreign matters such as grains, pebbles, and pod remnants were all manually removed from the beans seeds. The samples were then air-dried, grounded into the powdery form using a stainless electric grinder and stored in air-dried glass bottle containers ready for heavy metals and organochlorine pesticide residue analysis.

## HEAVY METAL DETERMINATION

### Acid Digestion

2 g each of the powdered samples was weighed into a 250ml beaker and 10 ml of Aqua regia (1:3 $HNO_3$ and HCl) was added. It was then placed on a heating mantle at 105$^{0}$C and heated for 3 hours until the entire sample are completely digested. A serial dilution of 1: 1 of the aliquot was done and made up

with distilled water in a 100 ml standard flask (AOAC, 2012).

**Heavy Metals Analysis**

The concentration of Lead (Pb), Cadmium (Cd), Copper (Cu), Manganese (Mn), Nickel (Ni), Chromium (Cr), and Iron (Fe) in the digested solutions was determined using Buck scientific atomic absorption spectrophotometer (model 210A). The instrument was calibrated with standard solutions of the heavy metals of interest and Blank determination was carried out after five determinations. Statistical Analysis of the results was carried out by calculating the mean and standard deviation (Haware and Pramond, 2011).

**PESTICIDES DETERMINATION**

**Extraction Process**

0.2 g of each sample was weighed and soaked with 20ml of dichloromethane (DCM) in a 250 ml amber bottle and kept for 72hrs after which the resulting solution was filtered.

**Clean Up/ Pre-Concentration**

The cleanup of the sample solution was done using the solid phase extraction method as reported by Oyekunle *et al* (2017). Each of the sample solutions was passed through a column packed with anhydrous Sodium sulfate and silica gel to remove water and other impurities that can damage the column. 50 ml of the extract was then concentrated through a rotary evaporator.

**GC-MS Analysis**

The Gas Chromatography mass spectra (GC-MS) (model Agilent Technology HP 5µs) were used for the quantification of organochlorine pesticides present in the bean samples and were calibrated before use with stock solutions of the organochlorine pesticides. Standard solutions of the pesticides were run on GC/MS under the set chromatographic conditions and mean peak areas were plotted against concentrations to obtain calibration curves of individual pesticides. The concentrate of each sample was later introduced into the instrument for organochlorine pesticide residue analysis.

**RESULTS AND DISCUSSION**

**Heavy Metals**

The concentration of heavy metals (Cd, Cu, Pb, and Fe) in the collected beans samples was determined and the results were presented in Table 1. All the metals analyzed in this study were detected in the two varieties of the beans samples except Cd which was found to be below the detection limit in the Oloyin beans sample. The level follows this trend: Cd<Pb<Cu<Fe (Oloyin) and Pb<Cd<Cu<Fe (Olotu). The concentrations of Cu, Pb, and Fe were found to be more in the Olotu sample compared to Oloyin.

It was observed that no Cadmium was detected in *Oloyin* beans but *Olotu* beans were found to contain 0.044 mg/kg. Also, Lead was found in the two varieties of the beans selected for this study, *Oloyin* contains 0.063 mg/kg and 0.011 mg/kg in the *Olotu* sample. The concentrations of both Cd and Pb were within the acceptable safe limit set by FAO/WHO (0.200 mg/kg) (Sulyman, *et al.,* 2015) and lesser than the levels reported by Olutona and Aderemi, (2019) in beans samples from Ibadan. The presence of Cd and Pb in the analyzed samples could be attributed to vehicular emission, the nature of soil used in planting, and fertilizers containing trace heavy metals. Nonetheless, one should not overlook the fact that if these metals are not eliminated at the rate at which they bioaccumulate they may pose a serious health risk to their consumers. This can be attributed to the plant uptake from the soil where it was grown, as Copper and Iron are essential minerals to the body.

**Detection Limit and recovery study**

**Table1: Mean concentration of Heavy metals present in the collected beans samples (mg/kg)**

| S/N | Beans Varieties | Cd | Cu | Pb | Fe |
|---|---|---|---|---|---|
| 1. | Oloyin | BDL | 0.073±0.0001 | 0.063±0.0001 | 0.132±0.0002 |
| 2. | Olotu | 0.044±0.0001 | 0.054±0.0001 | 0.011±0.0001 | 0.278±0.0001 |

**BDL – Below detectable limit**

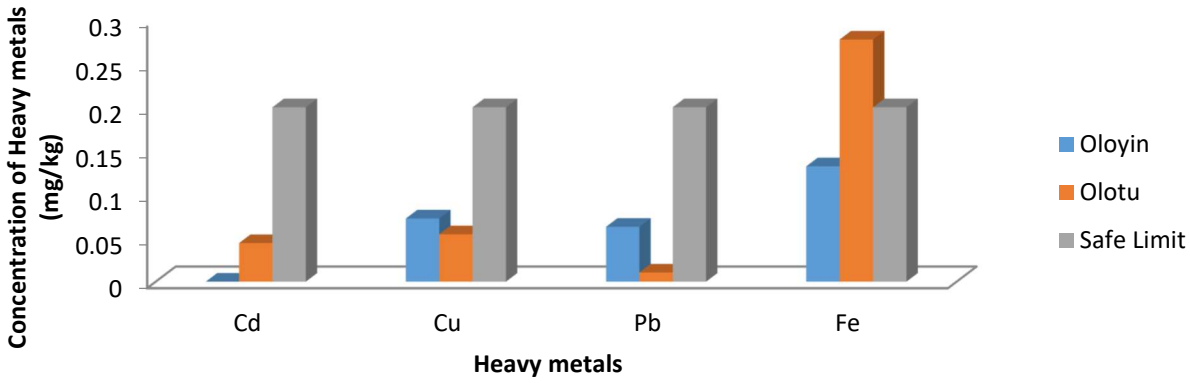


**Figure 1: A graph of the Concentration of Heavy Metals in the Bean samples of *Oloyin* (Honey beans) and *Olotu* (Brown beans) compared with safe limit.**

**PESTICIDES RESIDUE – ORGANOCHLORINE PRESENTS IN THE BEANS**

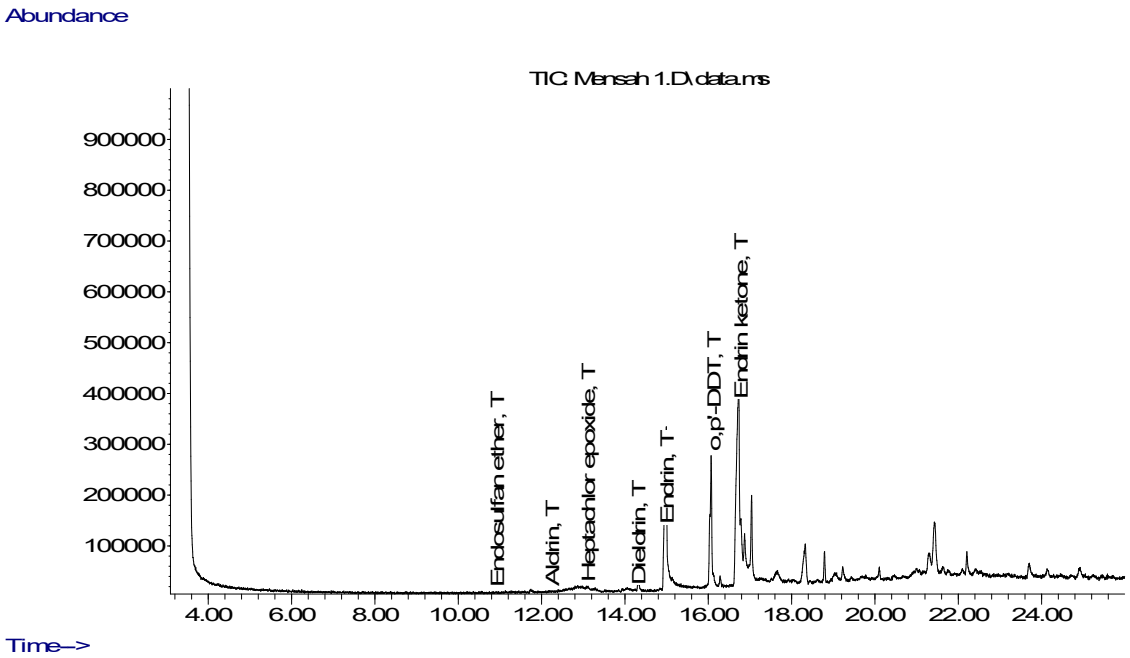


**Fig. 2: GCMS of organochlorine pesticide residue presents in *oloyin* beans.**

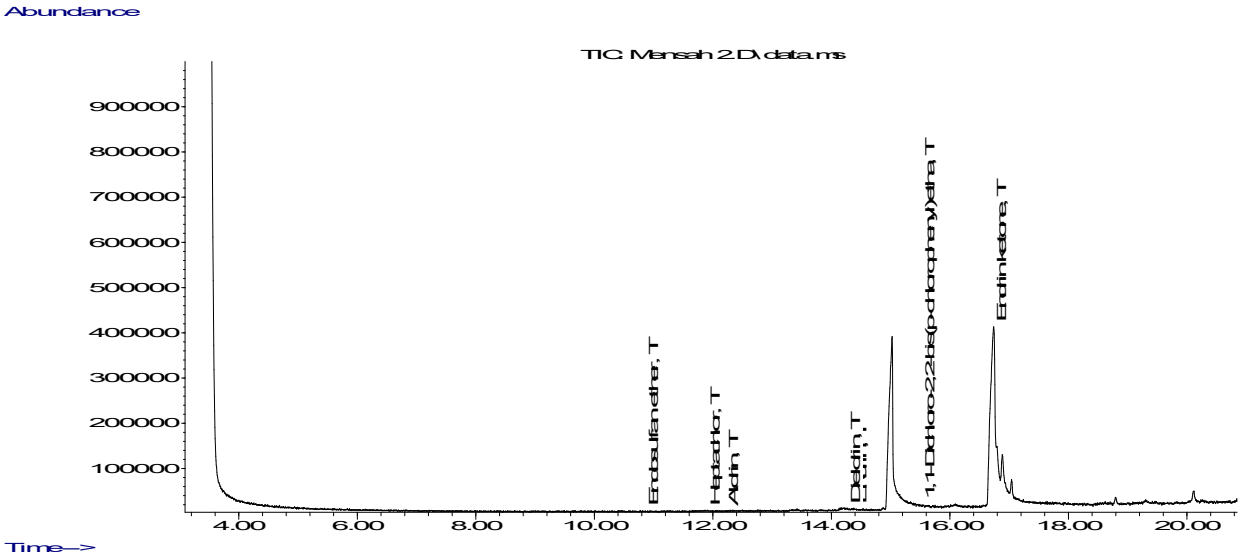


**Fig.3: GCMS of organochlorine pesticides residue presents *Olotu* beans**

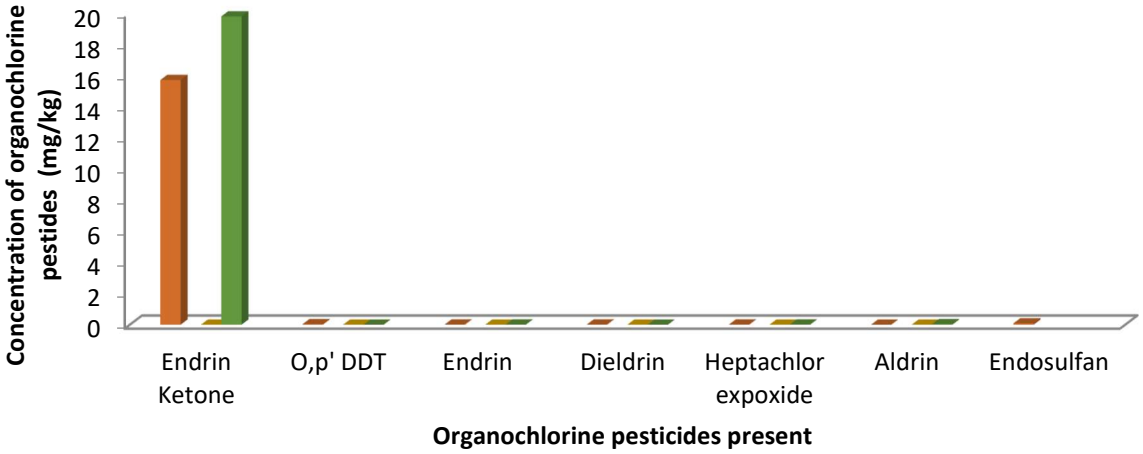


**Figure 4: Comparison in the number of organochlorine pesticides present in the beans seed of *Oloyin* (Honey beans) and *Olotu* (Brown beans)**

The result of the GCMS analysis indicated the presence of some organochlorine pesticide residue present in *oloyin* and *olotu* beans samples respectively as shown in Figures 2 and 3. The presence of Endrin, Dieldrin, Heptachlor, Endrin Ketone, Aldrin, endosulfan, and o.p'DDT were detected in the two varieties of the beans samples, with Endrin Ketone having the highest concentration in *oloyin* (15.740 mg/kg) and *olotu*(19.82 mg/kg) samples which are higher than the permissible limit. Endrin, Dieldrin, and Heptachlor all have 0.010 mg/kg found in both beans. However, for both beans, Aldrin was below the detection limit (BDL).The residue levels reported in this study for Endrin, Dieldrin, and Heptachlor were lower and within the food-safe limit of 0.3 mg/kg (Wandiga*et al.,*2002). But of great concern is Endrin Ketone with high residue in Oloyin (15.74 mg/kg) and Olotu (19.82 mg/kg) respectively. These levels are higher than the levels recorded by Olutona and Aderemi (2019) for pesticide residues in beans. The difference could be attributed to variations in geographical locations, time differences in terms of the period of study, and the extent of previous use of these pesticides on the farmland. Exposure to this can cause harmful effects like convulsion (>0.2mg/kg of body weight), dizziness, nervousness, vomiting, and death (ATSDR, 2015) Thus, organochlorines pesticides residue pose potential health hazards to the environment. Therefore, the maximum residual limit must be

monitored to check its effect on plants, animals, and man (Nakata *et al.,* 2002).

## CONCLUSION

This study indicates the presence of toxic heavy metals (Lead and Cadmium) on average but was within the safe limits when compared with the FAO/WHO standard. Nonetheless, one should not overlook the fact that these toxic elements accumulate in the body tissue with time due to the frequency of exposure. High levels of pesticide residues recorded in this study indicated that the pesticides are still widely in use in beans. So it is essential for agricultural activities and other human activities that increase heavy metal and pesticide residue contamination on foodstuffs to be controlled. It is important to put a check on the use of organochlorine pesticides used to prevent hazardous effects and provide a safe environment for their use and consumption. In addition, farmers and bean sellers should be educated against the indiscriminate use of pesticides.

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**CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest