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Consistent Organochlorinated Pesticides (OPC) Residues Contamination in Beans Consumed in Gombe Metropolis Nigeria

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ABSTRACT

Most of the locally consumed beans in our vicinity contain excess chemicals of pesticides residues which are harmful to humans and environmental hazards to ecosystem. Investigation of this study revealed contamination level of organochlorine pesticides residues in dried beans originating from Nigeria with a view to controlling them, it also studies crude fiber of beans showed that B4 has the highest fiber content, 27.85% and the order of decreasing value as B4, B5, B1, B3 and B2. The least percentage of crude fiber was shown by B2 in all the beans samples analyzed. This study also investigated the pesticides residue components of the organochlorinated pesticides test. The presence of pesticide residues in all 14 types of organochlorine pesticides in beans is lower than a previously reported level. Despite this, the amount of organochlorine pesticides tested is more than the permitted levels of 0.01 to 0.2 mg/kg, indicating that the beans consumed in the Gombe metropolis included pesticide residues beyond the permissible limit.

INTRODUCTION

Frequent utilization of pesticides through agricultural practice has protected crops against destructive pests and pesticide use has improved crop yield. Foods associated with these residue causes impacts to humans, animals and environmental hazard to the ecosystem, Organochlorinated Pesticides (OCP) originated from chemical pesticides residue from the farm [1–7].

Pesticides residues usage were intended to kill pests by disrupting their nervous system, which corresponds to the biochemistry among many different organisms. Reports also showed that these chemicals can harm humans as well as stated by Popp et al. [8]. Epidemiological studies showed positive correlations between exposure to pesticides through the occupational hazard, which tends to the significantly higher than the ingested by the general population through food and the occurrence of certain cancers [9–12]. Most of the general population which tend to be exposed to a large portion of pesticides were affected by pesticides residues that are attached to their lipophilic and can be bio-accumulate in their body systems [13–15,11,16]. Eating an organic diet can remedy the harmful effects of children's exposure to pesticides. Studies have found that children who eat conventional diets have significantly

higher levels of OP pesticide metabolites in their urine than do children who eat organic diets [17]. According to the research by Isegbe [18], who revealed that the presence of endrin-aldehyde, heptachlor epoxide, endosulfan I and in the sampled dried beans was investigated. These results, therefore, provided baseline information on the contamination level of organochlorine pesticides residues in dried beans originating from Nigeria with a view to controlling them. The highest level of diazinon organochlorine phosphate was detected the day after the spraying of station 1 in the amount of 1.14 ppm. Generally, in the other stations, the mean level of diazinon pesticides residue was lower than the standard acceptable levels as previously reported [19].

MATERIALS AND METHODS

Sample Collection

Five different samples of beans commonly consumed in Gombe have collected altogether. Samples were identified with local names and coded as B1 = brown beans, B2 = Bossoc beans, B3= Yabbarere, B4 = Kanannado and B5 known as Farin wake from Gombe. These different samples of beans were collected from two major markets in Gombe Metropolis. Then two corresponding samples were mixed together to form

representative fractions suitable for the analysis as adopted by [20].

Sample Preparation

The homogeneous beans samples were grounded and sieved with sieve size 20. The sieve samples (20 g each) were weighed and mixed with 100cm^3 of petroleum ether. The mixture was transferred into a separator and vigorously shaken for 1-2 minutes. Then 10 cm^3 sodium chloride and 600 cm^3 of distilled water were added. The separator was placed in a horizontal position for mixing that allowed to be mixed. The aqueous layer was discarded, and the solvent was washed twice with 100 cm^3 distilled water. Then 15 g anhydrous Sodium sulphate was added and shaken vigorously and left for 1 h to prevent loss of organochlorine pesticides by adsorption. The mixed samples were extracted with Acetonitrile together with aliquot or non-fatty foods. The entire solution of the samples was diluted with H$_2$O and the pesticides residues were extracted with petroleum ether. Further purification was done by column chromatography using eluting solvents of petroleum ether and diethyl ether. Residues in concentrated eluates were measured by Gas-Chromatography-Mass Spectrometry (GC- MS) and identified by a combination of Gas - Chromatography as adopted by [21].

RESULTS AND DISCUSSIONS

Crude fiber of beans

The result of crude fiber analysis of the beans shows the insoluble residue of acid hydrolysis. The quantity of indigestible cellulose and other components in all the samples were measured as shown in **Fig. 1**. The data showed that B4 has the highest crude fiber content in decreasing order of 27.85 % > B5 = 27.16 % > B1 = 20 % > B3 = 12.55% > B2 = 5.05 %. The least percentage of crude fiber was shown by B2 in all the beans samples analyzed. The result is contrary to the investigations by Mamta and Darshan [22] which stated that the cowpea bean vegetable had the highest crude fiber range from 17.19% to 5.54% in the samples analyzed.
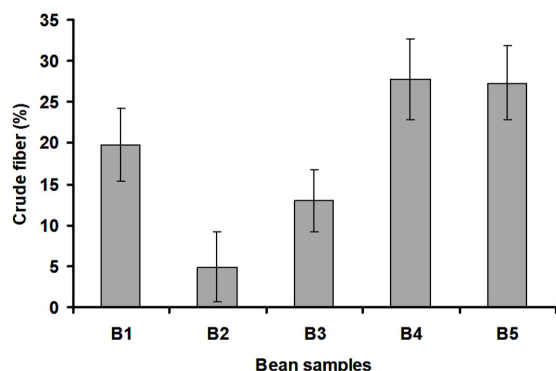

Fig. 1. Crude fiber of beans. Error bars represent standard deviation of triplicate.

Organochlorinated Pesticides(OCP) Components of Beans Sample

Illustrations in **Table 1** shows the calibration curve quantitation database for pesticides residue components of the organochlorinated pesticides test of beans samples, whereby **Table 1** showed the concentrations of fourteen major components pesticides residues in beans samples.

The pesticide residue component of poly phosphate-dichlorodiphenyldichloroethane (p,p' DDD) showed the highest coefficient of 0.9993 with an expected retention time of 9.913 followed by pesticide residue of methoxychlor with a coefficient of 0.9992 and retention time of 11.498. However, pesticide residue of p,p'-DDT component, showed the lowest coefficient of 0.9913 with a retention time of 10.491 shown by the tested components samples of beans. The calibration curves for the pesticides in bean sample matrices (**Figs. 2** to **15**) differ slightly in terms of sensitivity and linear range from published results [7,23–25] and may indicate sample matrix interference that should be further studied in future works. Suggestions on sample matrix removal include the use of dispersive solid-phase extraction using a microporous metal-organic framework [26] and fabric phase sorptive extraction in conjunction with gas chromatography and mass spectrometry [27].

This study investigated the pesticides residue components of the organochlorinated pesticides in five different beans B1-B5, which showed the presence of delta- lindane with a coefficient of 0.99808 ppm and 5.353 retention time, Alpha-lindane with an amount of 0.990 ppm and 5.851 retention time, beta- lindane with the amount of 0.997 ppm and retention time of 6.039, gamma- lindane with the amount of 0.995 ppm and retention time of 6.566, methoxychlor with 0.999 ppm and retention time of 11.498, heptachlor with amount 0.996 ppm retention time 0f 6.766, aldrin showed 0.996 ppm and retention time of 7.321, heptachlor epoxide showed 0.998 ppm and retention time of 7.996, endosulfan 1 showed 0.998 ppm and retention time of 8.631, endosulfan 11 showed 0.994 ppm and retention time of 9.81, p,p' DDE showed 0.999 ppm and retention time of 9.078. p,p' DDD showed 0.999 ppm and retention time of 9.913, p,p' DDT showed 0.991 ppm and retention time of 10.49 and endrin showed 0.997 ppm and retention time of 9.46 accordingly.

This indicated that all the 14 components of organochlorine phosphate of beans analyzed contain a lower amount of pesticides residue compared to 1.14 ppm as reported by [19]. The amounts of components investigated are higher than the recommended values of 0.01 mg/kg to 0.2 mg/kg as stated by [28] therefore the beans consumed in Gombe metropolis are contaminated with chemicals of pesticides residues. The result also showed that B4 has the highest crude fiber content in decreasing order of 27.85 % > B5 = 27.16 % > B1 = 20 % > B3 = 12.55% > B2 = 5.05 %. The least percentage of crude fiber was shown by B2 in all the beans samples analyzed. The result is almost similar to the findings of [22] that crude fiber of cowpea beans ranges from 17.19% to 5.54%

Table 1. OCP Calibration of Beans.

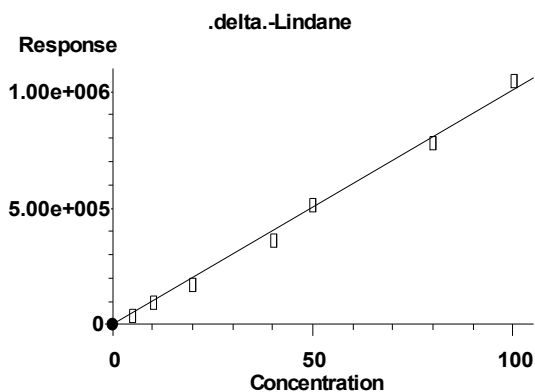| Peak Name	Exp RetTime	Coefl	Corr Coefficient	Curve fit type
.delta.-Lindane	5.353	10059	0.998	linear (0,0)
.alpha.-Lindane	5.851	5989	0.999	linear (0,0)
.beta.-Lindane	6.039	4144	0.998	linear (0,0)
.gamma.-Lindane	6.566	4032	0.996	linear (0,0)
Heptachlor	6.766	9974	0.997	linear (0,0)
Aldrin	7.321	1697	0.997	linear (0,0)
Heptachlor epoxide	7.996	10591	0.998	linear (0,0)
Endosulfan I	8.631	2368	0.998	linear (0,0)
p,p'-DDE	9.078	18255	0.999	linear (0,0)
Endrin	9.461	2815	0.997	linear (0,0)
Endosulfan II	9.781	1228	0.994	linear (0,0)
p,p'-DDD	9.913	27651	0.999	linear (0,0)
p,p'-DDT	10.491	22575	0.991	linear (0,0)
Methoxychlor	11.498	38318	0.999	linear (0,0)

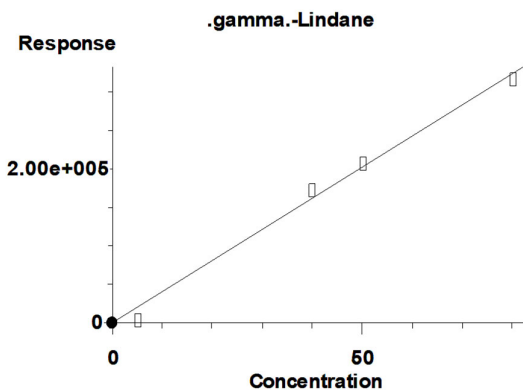**Fig. 2**. OCP of delta-lindane calibration curve.

Fig. 5. OPC of gamma -lindane calibration curve.
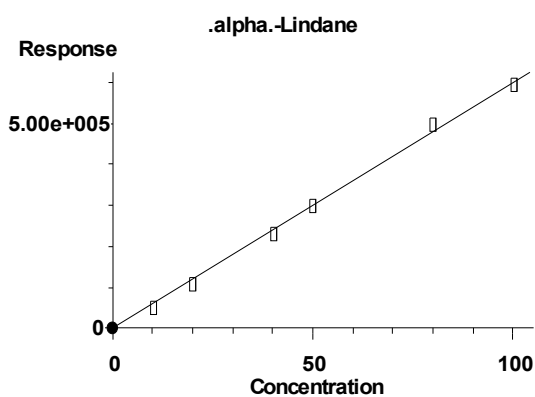

Fig. 3. OCP of alpha-lindane calibration curve.
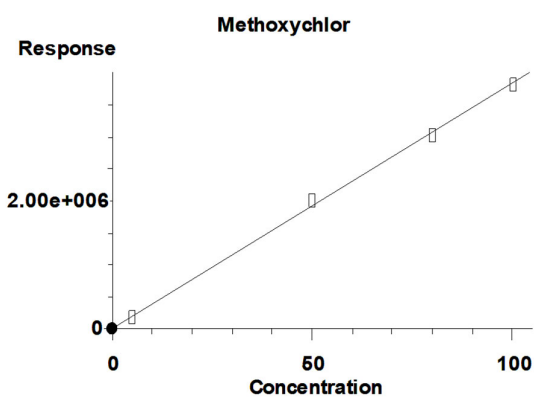

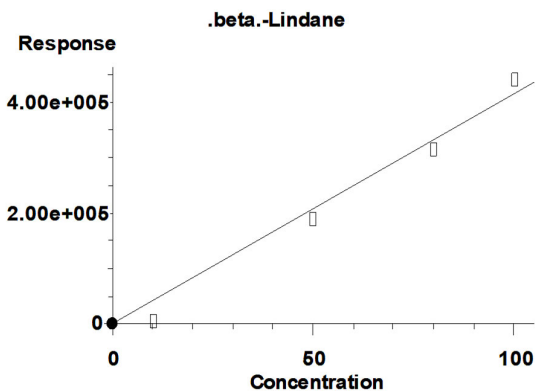**Fig. 6.** OPC of Methoxychlor calibration curve

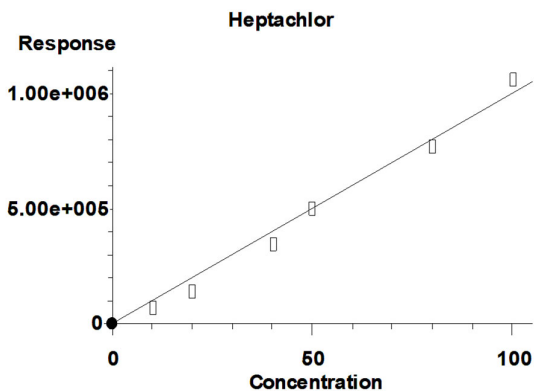**Fig. 4**. OPC of beta-lindane calibration curve.
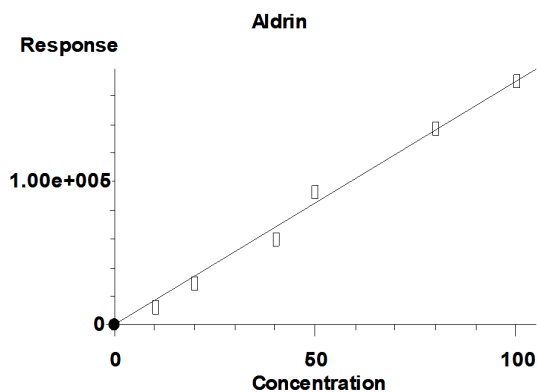

Fig. 7. OPC of Heptachlor calibration curve.
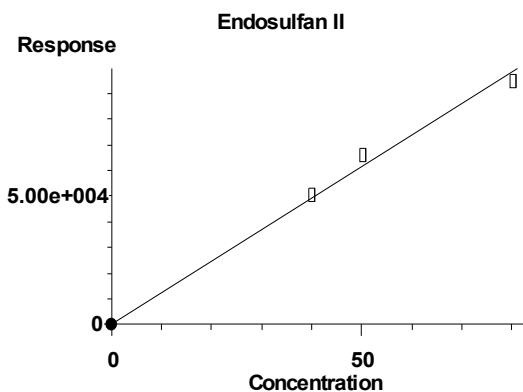
Fig. 8 OPC of Aldrin calibration curve.

Fig. 11 OPC of Endosulfan 11 calibration curve.
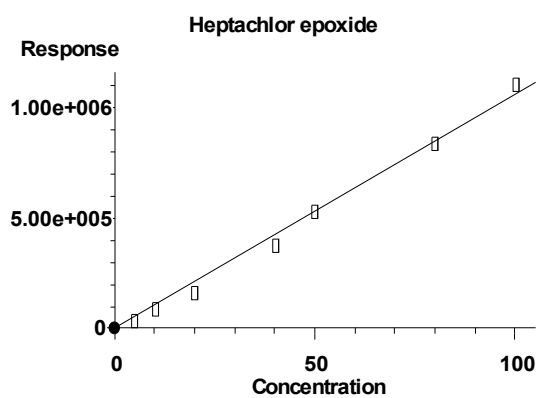

Fig. 9. OPC of Heptachlor epoxide calibration curve.
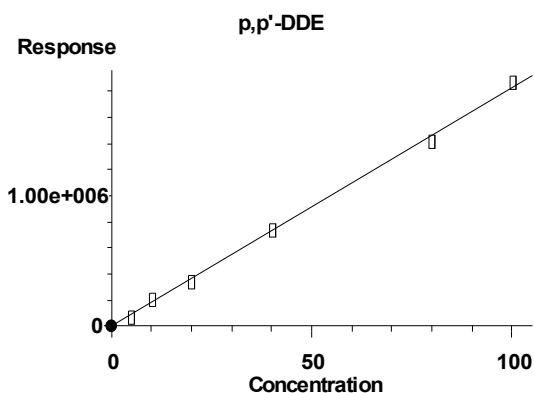

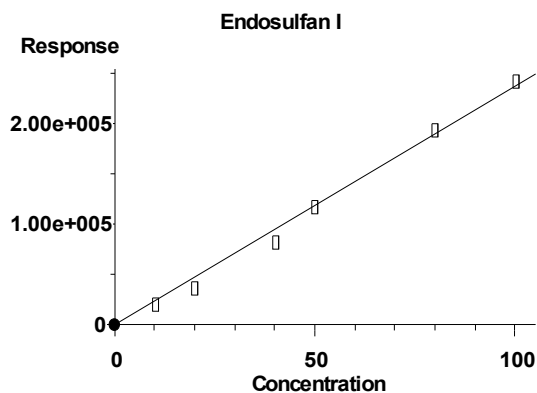**Fig. 12**. OPC of p, p'- DDE calibration curve.
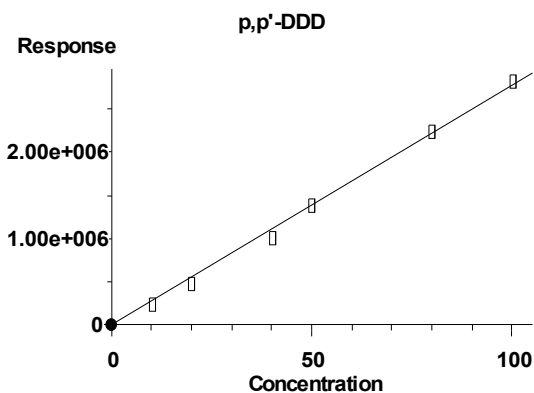

Fig. 10. OPC of Endosulfan 1 calibration curve.

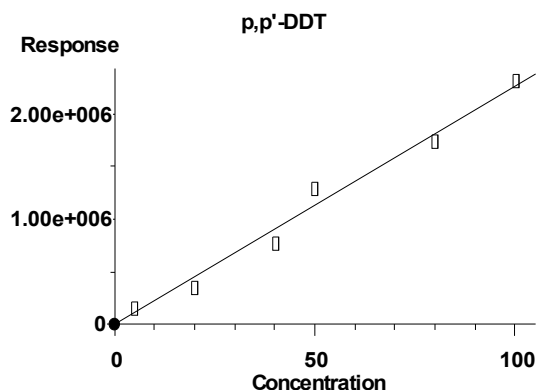**Fig. 13**. OPC of p, p'- DDD calibration curve.

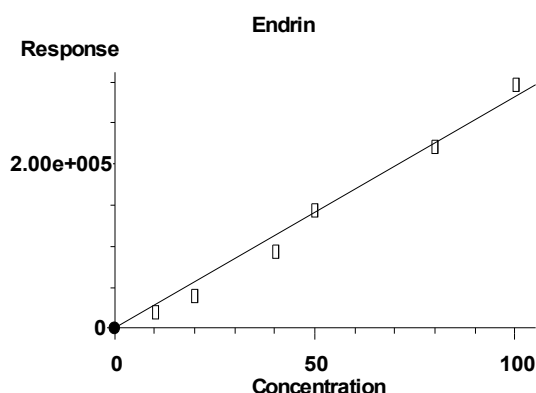**Fig. 14**. OPC of p, p'- DDT calibration curve.

Fig. 15. OPC of Endrin calibration curve.

CONCLUSION

This study investigated the fibre content in beans and pesticides residue components of the organochlorinated pesticides in five different beans which showed the presence of delta- lindane, beta- lindane, gamma- lindane, methoxychlor, heptachlor, aldrin, heptachlor epoxide, endosulfan 1 and endosulfan 11 p,p' DDE, p,p' DDD and p,p' DDT. This indicated that all of the 14 types of organochlorine pesticides in beans shows a lower amount of pesticides residue than a previously published result. Despite this, the amount of organochlorine pesticides investigated are higher than the recommended values of 0.01 to 0.2 mg/kg suggesting that the beans consumed in the Gombe metropolis contained pesticide residues above the permissible limit.

ACKNOWLEDGEMENTS

CONFLICTS OF INTEREST

The authors have not declared any conflicts of interest in any case.

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