WWJMRD 2018; 4(10): 36-39
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor MJIF: 4.25
E-ISSN: 2454-6615

Zira, S.P.
Department of Chemistry,
Adamawa State University,
Mubi Nigeria

Barminas, J. T.
Department of Chemistry,
Modibbo Adama University of
Technology, Yola Nigeria

Maina, H. M
Department of Chemistry,
Modibbo Adama University of
Technology, Yola Nigeria

Correspondence:
Zira, S.P.
Department of Chemistry,
Adamawa State University,
Mubi Nigeria

Determination of Persistent Organic Pollutants in Beef Consumed in Some Selected Areas in Mubi Adamawa State Nigeria

Zira, S.P., Barminas, J. T., Maitera, O. N., Maina, H. M

Abstract
The use of agrochemicals for pest control, weeds control and yield optimization has significantly increased output and reduced losses in the agricultural sector. However, they constitute major sources of environmental pollution. The samples were extracted and analyzed using Agilent GC-MS 7890A coupled with MSD 5975C. Six Organochlorines such as □-HCB, β-HCB, ϒ-HCB, heptachlor, dieldrin and Organophosphorus such as chlorpyrifos, methylparathion and malathion were determined from each sample. The observed concentration of organochlorines in the samples obtained from Mubi-North abattoir is 0.028ppm, 0.012ppm, 0.076ppm; 0.062ppm and 0.576ppm respectively while 0.030ppm, 0.021ppm and 0.027ppm for organophosphorus. Also the observed concentration of organochlorines in the samples obtained from Mubi-South abattoir is 0.023mg/kg, 0.016ppm, 0.087ppm, 0.048ppm and 0.320ppm respectively while 0.038ppm, 0.017ppm and 0.031ppm for organophosphorus. The observed concentrations at 0.083ppm, 0.062ppm, 0.095ppm, 0.058ppm and 0.023ppm respectively for organochlorine while 0.039ppm and 0.036ppm for organophosphorus in the samples obtained from Mubi main market. For the sample from Tsamiya mini market, a concentration is 0.086ppm, 0.067ppm, 0.087ppm, 0.049ppm and 0.021ppm for organochlorine while 0.041ppm and 0.023ppm for organophosphorus respectively. Sample from Lokuwa district reveals the concentration of organocholorine at 0.054ppm, 0.010ppm, 0.063ppm and 0.023ppm while 0.037ppm for organophosphorus respectively. Sample also obtained from Barama ward reveals the concentration of organochlorine at 0.048ppm, 0.097ppm, 0.057ppm and 0.021ppm while Organophosphorus shows 0.032ppm for chloropyrifos though methyl-parathion and malathion were not detected. From the results obtained, it is clear that the commercial beef sold within the study area are contaminated with different organochlorines and organophosphorus pesticide residues especially heptachlor, dieldrin, chlorpyrifos and malathion. Despite bans and restrictions placed on the use of some of these pesticides in Nigeria, their high concentrations in samples analyzed suggest either their persistence or continual usage.

Keywords: Beef, POPs, Organochlorine, Organophosphorus, Agrochemicals, GC-MS, HCB

Introduction
Meat is animal flesh that is eaten as food (Lawrie *et al.*, 2006). Meat is mostly the muscle tissue of animals. Most animal muscle is roughly 75% water, 20% protein, and 5%fat, carbohydrate and assorted proteins (Park *et al.*, 2007). Fresh meat can be cooked for immediate consumption, or be processed, that is, treated for longer-term preservation and later consumption, possibly after further preparation (Ronald *et al.*, 2004). According to a report produced by international panel for sustainable resource management (IPSRM), a worldwide transition in the direction of a meat and dairy free diet is indispensable if adverse global climate change were to be prevented (Shapouri, 2002). Meat can transmit certain diseases, but complete cooking and avoiding recontamination reduces this possibility (Corpet *et al.*, 1995).

Persistent organic pollutants are organic compound of natural or anthropogenic origin that possesses a particular combination of physical and chemical properties such that once released into the environment, they remain intact for exceptionally long period of time as they resist photolytic, chemical and biological degradation (Talanta *et al.*, 2010). Compound

of this nature are light resistant to degradation by biological, photolytic and or chemical means (Jenifer, 2014). These toxicants may induce toxicity effects such as cancer, skin lesions, reproductive failure and endocrine dysfunction (WHO, 2010). The dioxins are normally derived from wastes of chemical processes or natural disasters such as forest fires and volcanic eruption, combustion, waste household heating and Pump and pepper industries (Kathrine *et al.*, 2013). These POPs can be transported by wind and water, and can affect people and wild lives far from where they are used and released. They persist for long period of time in the environment and can accumulate and passed from one specie to the other through the food chain (USEPA, 2009). They can be carcinogenic and affect the hormonal balance, the nervous system and the reproductive system (Skemman, 2011). In this paper, we investigate the contamination level of beef samples sold within Mubi metropolis in terms of selected POPs.

Materials and Methods

Sampling and Sample Preparation

Fresh cow meat were randomly collected at the Mubi-North and Mubi-South abattoirs, stationary retailers situated at Tsamiya mini market and Mubi main market, hawkers located at residential areas of Barama and Lokuwa districts of Mubi local government area of Adamawa State, Nigeria.

Reagents used

The reagents used includes; hexane, toluene, dichloromethane and ethyl acetate and various pesticide standards for the pesticides under investigation.

Sample extraction

Samples of meat were subjected to solid material extraction procedure consisting of mixing with hexane, toluene, dichloromethane and ethyl acetate. The organic layer of this extraction was evaporated and the lipid residue was dried and weighed in order to calculate the levels of lipids in the matrices. The labeled quantification standards were added to each sample before the analysis (Indraningsih, 2015).

Sample analysis

Tissue sample of meat, 2–5g each was separated and homogenizes by addition of pre-treated sodium sulphate (Na_2SO_4) at the temperature of 600°C, for 8 hours in a ratio of 1:20. ^{13}C-isotope (20µl) labeled internal standards were added to each sample. The homogenized mixture was extracted three times using cold column extraction with 50ml cyclohexane: acetone (3:1 v/v). The extract (150ml) was concentrated to 0.5ml and collected in a 4ml vial. The amount of extractable lipid was determined gravimetrically. The extracts were cleaned-up using gel permeation chromatographic (GPC) and pre-packed florosil columns prior to analyses on a gas chromatography–mass spectrometry (GC-MS) instrument.

Data Analysis

Descriptive statistics such as mean, variance and standard deviation were used to analyze the results obtained.

Results and Discussion

Samples from Mubi-North and South abattoir

The data obtained from the investigation of some specified persistent organic pollutants in beef samples sold within Mubi-North and South abattoir area of Adamawa state, using GC-MS analysis.

Table 1: Mean concentration of organochlorine residues in meat from Mubi North and South abattoir

POPs	LOQ(ppm)	abattoir1(ppm)	abattoir2 (ppm)	EU/FAO MRL (ppm)
α-HCB	0.0074	0.028±0.03	0.023±0.06	0.01
β-HCB	0.0028	0.012±0.04	0.016±0.02	0.02
γ-HCB	0.0027	0.076 ±0.02	0.087±0.04	1.00
Heptachlor	0.0050	0.587±0.12	0.320±0.03	0.01
Dieldrin	0.0027	0.062±0.01	0.048±0.07	0.50

From the observed data it shows that higher concentration of α-HCB was found at Mubi-North abattoir with mean concentration of 0.028ppm compared with 0.023ppm of Mubi-South (Table 1). β-HCB showed a mean concentration of 0.012ppm in Mubi-North abattoir and 0.016ppm in mubi South-Abattoir (Table 1). Of all the HCB isomers, γ-HCB gave the highest residue concentration of 0.076ppm in Mubi-North abattoir and 0.087ppm in Mubi-South abattoir (Table 1). Heptachlor manifested a very high concentration of 0.567ppm in Mubi-North abattoir and 0.320ppm in Mubi-South abattoir. Dieldrin was found at mean concentration levels of 0.062ppm in beef from Mubi-North abattoir and 0.048ppm in Mubi-South abattoir. Except for heptachlor, all other pesticide residue determined was below their MRLs (Table 1).

Table 2: Mean concentration of organophosphorus in meat from Mubi North and South abattoir

POPs	LOQ(ppm)	abattoir1(ppm)	abattoir2 (ppm)	EU/FAO MRL (ppm)
chlorpyrifos	0.0013	0.030 ±0.21	0.038±0.003	0.05
M-parathion	0.0015	0.021±0.04	0.017±0.02	0.02
malathion	0.0018	0.027±0.004	0.031±0.007	8.0

From the POPs analysed, chlorpyrifos gave mean concentrations of 0.030ppm and 0.038ppm in beef samples from Mubi-North and South abattoirs respectively (Table 2). Methyl-parathion also showed mean concentration of 0.021ppm and 0.017ppm in Mubi-North and South respectively. Malathion gave mean concentration of 0.027ppm and 0.031ppm in Mubi North and South respectively (Table 2). Highest concentration of POPs found is chlorpyrifos in beef from Mubi-South abattoir with concentration of 0.038ppm, while the least is methyl parathion in beef from Mubi-South abattoir; all POPs determined were below their respective MRLs (Table 2).

Samples from stationary retailers at Mubi main market and Tsamiya mini market

The data obtained from the investigation of some specified persistent organic pollutants in beef samples sold at Mubi main market and Tsamiya mini market, Mubi area of Adamawa state, using GC-MS analysis.

Table 3: Mean concentration of organochlorine residues in meat from stationary retailers at Mubi main market and Tsamiya

POPs	LOQ(ppm)	market(ppm)	Tsamiya (ppm)	EU/FAO MRL (ppm)
α-HCB	0.0074	0.083±0.003	0.086±0.003	0.01
β-HCB	0.0028	0.062±0.004	0.067±0.026	0.02
γ-HCB	0.0027	0.095 ±0.001	0.087±0.004	1.00
Heptachlor	0.0050	0.058±0.029	0.049±0.003	0.01
Dieldrin	0.0027	0.023±0.01	0.021±0.05	0.50

It was observed that α-HCB showed high concentrations of 0.083ppm and 0.086ppm in beef sold from Mubi main market and Tsamiya mini market respectively (Table 3). β-HCB showed 0.062ppm and 0.067ppm in Mubi main market and tsamiya respectively. γ-HCB gave 0.095ppm and 0.087ppm in Mubi main market and Tsamiya mini market respectively (Table 3). 0.058ppm and 0.049ppm was observed for heptachlor from Mubi main market and Tsamiya respectively. Dieldrin gave concentrations of 0.023ppm and 0.021ppm in beef samples from Mubi main market and Tsamiya respectively. Of all oganochlorines analysed in beef from these areas, all where above their MRLs except for γ-HCB and dieldrin (Table 3).

Table 4: Mean concentration of organophosphorus residues in meat from stationary retailers at main market and Tsamiya

POPs	LOQ(ppm)	market (ppm)	Tsamiya (ppm)	EU/FAO MRL (ppm)
chlopyrifos	0.0013	0.039±0.021	0.041±0.03	0.05
M-parathion	0.0015	trace	0.023±0.02	0.02
malathion	0.0018	0.036±0.002	trace	8.0

It was investigated that chlorpyrifos showed mean concentrations of 0.039ppm and 0.041ppm for Mubi main market and Tsamiya respectively (Table 4). Methyl-parathion showed only trace amounts (concentration below LOQ) in beef from Mubi main market and a mean concentration of 0.023ppm in that of Tsamiya mini market. Mean concentration of 0.036 was observed for malathion in beef from Mubi main market while only trace amounts was found in beef from Tsamiya. All organophosphorus pesticides determined were below their MRLs except for methyl-parathion; this may suggest low usage of POPs or low persistence (Table 4).

Samples from hawkers around Lokuwa and Barama districts

The data obtained from the investigation of some specified persistent organic pollutants in beef samples sold at Lokuwa and Barama districts, Mubi area of Adamawa state, using GC-MS analysis.

Table 5: Mean concentration of organochlorine residues in meat from hawkers around Lokuwa and Barama districts.

POPs	LOQ(ppm)	Lokuwa(ppm)	Barama (ppm)	EU/FAO MRL (ppm)
α-HCB	0.074	traces	trace	0.01
β-HCB	0.0028	0.054±0.05	0.048±0.028	0.02
γ-HCB	0.0027	0.100 ±0.001	0.097±0.004	1.0
Heptachlor	0.0050	0.063±0.006	0.057±0.007	0.01
Dieldrin	0.0027	0.023±0.002	0.021±0.003	0.50

From the above data, it was observed that only traces of α-HCB were found for both locations (Table 5). β-HCB showed mean concentrations of 0.054ppm and 0.048ppm for Lokuwa and Barama respectively. For both locations concentration was far above MRLs. γ-HCB usually the most predominant isomer of the HCB shows mean concentrations of 0.100ppm and 0.097ppm. Even at such high concentrations, they are still below their MRLs (Table 5). Heptachlor shows concentrations of 0.063ppm and 0.057ppm for Lokuwa and Barama respectively. Residues of heptachlor present in beef for both locations are above MRL. Dieldrin gave mean concentrations of 0.023ppm and 0.021ppm for Lokuwa and Barama respectively. Dieldrin residues for both locations were below its MRL (Table 5).

Table 6: Mean concentration of organophosphorus residues in commercial beef from hawkers around Lokuwa district and Barama district

POPs	LOQ(ppm)	Lokuwa (ppm)	Barama(ppm)	EU/FAO MRL (ppm)
chlorpyrifos	0.13	0.037±0.006	0.032±0.08	0.02
methyl-parathion	0.15	trace	ND	0.02
malathion	0.18	trace	ND	0.01

From the table above, Chlorpyrifos gave mean concentration of 0.037ppm and 0.032ppm for Lokuwa and Barama respectively, which are slightly above its MRL. Only traces of methyl-parathion and malathion were found in samples from Lokuwa and Barama, and not detected in samples from both locations (Table 6).

Conclusion

From the results obtained, it is clear that the commercial beef sold within the study areas are contaminated with different organochlorines and organophosphorus pesticide residues especially; heptachlor, dieldrin, chlorpyrifos and malathion. Despite bans and restrictions placed on the use

of some of these pesticides in Nigeria, their high concentrations in samples analysed suggest either their persistence or continual usage. For samples whose concentrations exceed their MRLs, consumers of such products are at risk of its potential toxicity. Nevertheless, even those with concentrations below MRLs may not be regarded as safe due to their potential synergistic effect such that even POPs at low concentrations may cause serious health hazards. This suggests a proper public sensitization on the hazards associated with the use of pesticides, monitoring and assessment of treated grazing lands and lakes at the beginning and end of every farming season in order to reduce the uptake of these POPs by the animals.

Acknowledgements
Author acknowledges the contributions of Aghalakwa Daniel, Dlama Stephen, Panesum J. Tukur and Apinega L.A. and the staff of the Department of Petroluem Chemistry, American University of Nigeria (AUN), Yola, for supplying us with the GC-MS machine used in this study and other people who made this studies a successful one.

References

1. Corpet, D., Yin Y., Zhang, X., Rémésy, C., Stamp, D., Medline, A., Thompson, L. and Bruce, W. (1995): Colonic protein fermentation and promotion of colon carcinogenesis by thermalized casein. Nutritional Cancer. **23(**3): 271–81.
2. Indraningsih, Y. S. (2015): Residues of Persistent Organic Pollutants in Beef Cattle. *International Journal of Agriculture Innovations and Research*, **4**(3): 581-589.
3. Jennifer, P. (2014): Thermo fisher Scientific, Bannacktum, IL, U.S.A. *Rapid determination of persistent organic pollutants (POPs) using accelerated solvent extraction.*
4. Katherine, K. Stenerson, Michael, Y., Michael, H., Olga, S. and Leonerd, M. (2013): *New analytical tool for determination of persistent organic pollutants (POPs) in fatty food and beverage matrices using Quick Easy Cheap Effective Rugged Safe*.
5. Lawrie, R. A. and Ledward, D. A. (2006): *Lawrie's meat science* (7th edition). Cambridge: Woodhead Publishing Limited. ISBN 978-1-84569-159-2.
6. Park, S. Y., Murphy, S. P., Wilkens, L. R., Henderson, B. E. and Kolonel, L. N. (2007): Fat and meat intake and prostate cancer risk: The multiethnic cohort study. *International Journal of Cancer*.**121** (6):
7. Ronald, B. P. and Fereidoon, S. (2004). *Nitrite Curing of Meat*: The N-Nitrosamine Problem and Nitrite Alternatives. John Wiley & Sons. ISBN 0-917678-50-8
8. Shapouri, H. (2002): The energy balance of corn ethanol: an update. *USDA Agricultural Economic Report* 814.
9. Skemman, (2011): *Occurrence of Different Persistent Organic Pollutants in Atlantic cod (Gadusmorhua L) in Icelandic water*.
10. Talanta, E.L., Shahawi, M.S., Hamza, A., Bashammakh, A.S. and Alshaggaf, W.T. (2010): *An overview on the accumulation, distribution, transformation, toxicity,and analytical method for the monitoring of persistent organic pollutants.*
11. United States Environmental Protection Agency (2009): *Persistent Organic Pollutants*: A global response United State Environmental Protective Agency.
12. World Health Organisation (WHO). (2010): *Persistent organic pollutants*; impacts on child health. Geneva: world health organisation library.