



Research paper

Occurring the paraquat residues in various Nigerian Saviour Aletor

Department of Agricultural Economics, University of Uyo, Nigeria

ARTICLE INFO

Keywords:

Paraquat residues
 Occurrence
 Nigerian
 Crops
 Fruits
 Vegetables

*Corresponding Author:

Saviour Aletor
Savi.aletro@gmail.com

Received: 22 May, 2021

Accepted: 16 Aug, 2021

Available online: 30 Sep, 2021



This work is licensed under the Creative Commons Attribution 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

ABSTRACT

Because pesticides are ubiquitous and focused on the food chain, they are a substantial source of possible environmental danger to humans and animals. The highest extremely hazardous herbicides to be launched in 60 years ago is paraquat (1,1'-dimethyl-4,4'-bipyridylum dichloride). Although most nations have prohibited or severely limited the use of paraquat (PQ), it is still used in others, particularly in Nigeria. As a result, the present study used a spectrophotometric method to look for PQ in some vegetables, crops, and fruits in Abeokuta that are commonly consumed. The presence and amounts of PQ residues were assessed in 150 samples of various vegetables, crops, and fruits (harvested at Fadama field of the University of Agriculture, Abeokuta). PQ residues were detected in Talinum triangulare, Corchorus olitorius, Amaranthus caudatus, Cratylia argentea, Capsicum frutescens, Lycopersicum esculentum, Raphanus sativus, Zea may, and Dioscorea alata at 0.130.02, 0.27+0.02, 0.06+0.01, 0.10+0.03, 0.15+0.03, 0. Using this technique, no paraquat residues were found in M. paradisiaca or C. papaya. At 0.05-1.0 ppm fortification level, the technique yields a mean recovery of over 80% and is reproducible with a total coefficient of variation of 8.0 percent (n=10). All residual levels found were under the PQ tolerance or pesticide maximum limits.

Introduction

Pesticide residue monitoring is one of the most difficult tasks faced by regulatory authorities in most developing and industrialized countries. A pesticide residue monitoring program is necessary to ensure that all national and international maximum residual standards are met. Pesticide residues in food are usually measured using monitoring data to determine dietary intake (Constenla, Riley et al. 1990, Agrochemicals 1993, Osfor, El Wahab et al. 1998).

Paraquat (PQ) was developed in England in 1956 and has since been utilized in agriculture globally due to its excellent herbicidal properties, which have resulted in significant economic advantages. In many agricultural and non-agricultural regions, grasses and weeds are controlled. It's used for pre-plant or before the emergence of potatoes, grains, vegetables, and peanuts; after the emergence around soybeans and fruit crops during the dormant season on clover and other legumes; and after the emergence on clover and other legumes during the dormant season. Some countries have classed

paraquat products as limited pesticides, and some have outright banned them (Selisker, Herzog et al. 1995). Agrochemical residues have been found in meals, crops, vegetables, milk, and milk products in numerous nations, according to various writers (Van Emon, Seiber et al. 1987, Antonio and Manuela 1995, Kinyamu, Kanja et al. 1998).

Poisoning has been recorded after ingesting such plants and animal products on many occasions. Growers' overuse of pesticides or failure to observe a safety interval after harvest were blamed for these instances. People were reportedly exposed to paraquat residues through their food (Ahmed and Ismail 1995, Grandjean and Landrigan 2006). The determination of herbicide levels in plants and plant products is important since such values are useful indicators of herbicide contamination in the environment. The goal of this study was to quantify paraquat residue levels in some commonly consumed vegetables, fruits, and crops in Abeokuta, Nigeria to determine whether humans are predisposed to this herbicide and its related health risks, such as Parkinson's disease, Alzheimer's disease, and Amyotrophic lateral sclerosis (Rai, Das et al. 1997).

Materials and Methods

Randomly chosen samples of different crops, vegetables, and fruits, including Zea mays (Agbado, Maize), Lycopersicon esculentum (Tomato), Raphanus sativus (Radish), Chochorus olitorius (Ewedu, Nalta jute), Amaranthus caudatus (Efo tete, Tassel flower), Talinum triangulare (Gbure, Waterleaf), Celocia agent (Isu ewura, Water yam). Carica papaya (Ibepe, Pawpaw) and Musa paradiscicica (Ogede agbagba, Plantain) were taken from the Fadama Farm of the University of Agriculture, Abeokuta, where paraquat had been applied as a preemergence herbicide (at a rate of 2.2 Kg PQ/ha).

The control samples were taken from the field of a subsistence farmer who had no previous history or record of PQ use. One of the distributors acquired PQ in the form of paraquat dichloride (Syngenta, Zwiterland) (C.ZARD, Nig Ltd.). Aldrich Chemicals provided calcium carbonate, sodium dithionite, and sodium hydroxide, while BDH Ltd provided sulphuric acid (analytical reagent grade). The gear utilized included a spectrophotometer (Jenway, Type 6405 uv/vis) and a centrifuge (JOL-802 Finlab, U.K., model TDL 80-2).

Preparations of samples

The samples selected randomly of the crops, fruits, and vegetables mentioned above were washed and rinsed with deionized water, copped, blended, homogenized, and centrifuged at 5000 rpm for 30

minutes from a 'homogeneous lot' (same plantation, same paraquat treatment, and same harvest date) on the Fadama farmland. The analysis was performed on the resulted supernatant. Throughout the trial, examination gloves (Top glove SDN BHD, Selangor D.E, Malaysia) were used.

Extracting the paraquat residues

Selisker, Herzog et al. (1995) reported an extraction technique that was derived from Van Emon, Seiber et al. (1987). The representative analytical sub-samples (2.5 g) were weighed into 25 ml calibrated polypropylene tubes, which were then capped and sonicated after adding concentrated tetraoxosulphate (VI) acid (2.5 ml 6 N H₂SO₄). With 6 N H₂SO₄, the volume was increased to 5.0 ml and agitated for roughly 10 minutes in an orbital shaker. Then, the mixture was centrifuged for 10 minutes at 5000 rpm. The supernatant was collected with care and stored at 4°C until needed.

Spectrophotometric determination of PQ residues

PQ residues in extracted samples were determined according to Rai, Das et al. (1997). 20 ul of the supernatant was combined with 4.9 ml of 0.01 M sodium acetate buffer (pH 5.0). Then, 2.0 ml of 1 percent (w/v) aqueous sodium dithionite and 1 ml of 0.1 N sodium hydroxide were added. After allowing the mixture to sit for 2 to 5 minutes, the paraquat residues were measured using a 600 nm absorbance spectrophotometer. Figure 1 shows a standard calibration curve generated using commercially available PQ as a standard to determine the quantity of PQ residues. Samples of each crop, vegetable, and fruit were spiked with known concentrations of PQ (0.01 to 0.5 ppm), and extraction was carried out as stated before, with the mean % recovery level calculated.

Results and Discussion

Table 1. Paraquat residues in some vegetables, crops and 1 fruits.

Sample	Residues
T. triangulare	0.13
C. olitorius	0.27
A. caudatus	0.06
C. argentea	0.10
C. frutescens	0.15
L. esculentum	0.09
R. sativus	0.09
Z. mays	0.04
D. alata	0.05
M. paradiscicica	ND
C. papaya	ND

Table 1 shows the results of the amounts of PQ residues determined from each sample examined. The lowest (0.04 ppm) and highest (0.27 ppm) amounts of PQ residues were found in *Z. mays* and *C. olitorius*, respectively. The observed discrepancies might be explained by the fact that these plants have distinct shapes and morphologies. The greatest PQ level found in *C. olitorius* might be ascribed to the plant's high fat content, as well as the nature of its leaf system, which is responsible for the preservation of this chemical. PQ has been known to be lipophobic, thus it's not unexpected that *Z. mays* seeds, which are mostly carbohydrate, contained the fewest PQ residues. The maximum amount of PQ residues found in these investigations was much lower than that found in potatoes by [Wigfield, McCormack et al. \(1993\)](#). Furthermore, the quantity of PQ residues discovered in *Z. mays* in this research (0.04 ppm) did not match with Plant Protection Ltd.'s (1986) report, which found a mean PQ level of 0.08 ppm in maize. The discrepancies might be related to the different sensitivity levels of the methods utilized. The maximum residue limits (MRLs) for PQ in maize, soya bean fodder, leafy greens, root and vegetables, according to Codex online data, were 0.07, 0.05, 0.5, and 0.05 mg/kg, respectively (Codex Alimentarius, 2006). PQ residues in coffee berries and beans in Costa Rica were likewise at or below the limit of detection of 0.02 mg/kg, according to [Camoni IV, Fabbrini et al. \(2001\)](#).

According to the European Union's (EU) monitoring report on pesticide residues in food, samples with residues exceeding MRLs occur 5.5 percent of the time, whereas samples with residues at or below the MRLs occur 4.4 percent of the time. Among the compounds discovered to be above the MRLs were dimethoate, methiocarb, methomyl, and bromopropylane. Cucumber (3 percent), Grapes (5 percent), and aubergines (3 percent) all have high levels of exceedances ([Epa 1993](#), [Rusibamayila, Ak'Habuhaya et al. 1998](#)). *T. triangulare*, *C. olitorius*, *A. caudatus*, *C. argentea*, *C. frutescens*, *R. sativus*, *Z. mays*, *L. esculentum*, *D. alata*, *M. paradisiaca*, and *C. papaya* each had a percentage recovery of around 80, 85, 85, 85, 85, 85, 85, 85, 85, 85, 85, 85, 85. It's possible that the largest concentrations of PQ residues were found in *C. papaya* and *M. paradisiaca*, which might have resulted from continual buildup because of their perennial nature. Conversely, using the aforementioned approach, PQ residues in these plants were not detected.

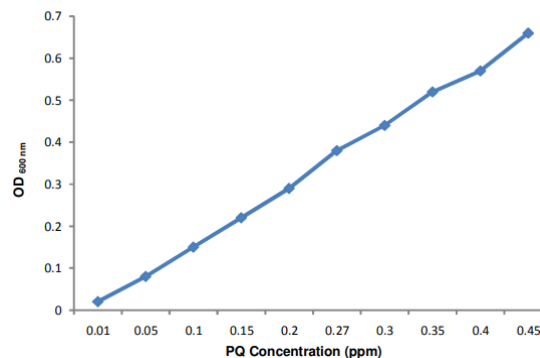


Figure 1. Calibration curve for paraquat residue concentration determination.

The current preliminary findings indicated that PQ residues discovered were below the maximum residue limits (MRLs) of 0.5 mg/kg established by the UK pesticides levels in crop foods and feedstuffs in all of the randomly selected samples examined ([Andersen and Poulsen 2001](#)).

Furthermore, this is in line with [Kinyamu, Kanja et al. \(1998\)](#), who found that users of treated crops were exposed to relatively little PQ since the great majority of PQ applications do not lead to measurable residues (>0.5 mg/kg) in food. As a result, it does not appear that consuming these plant products poses a major health risk to consumers. However, the possibility of negative long-term consequences from the buildup of this molecule in the body cannot be rejected or dismissed. As a result, further research is needed in this area.

As far as we know, the present research is the first time a spectrophotometric technique has been used to detect PQ residues in Nigerian crops, vegetables, and fruits; the research on using a high-performance liquid chromatographic technique to make quicker, more concise, and perhaps more precise determinations is currently ongoing.

Conflict of interest

The authors declare that they have no conflict of interest.

References

- Agrochemicals, Z. (1993). "The determination of paraquat in crops-A spectrophotometric method." ICI Plant Protection Division, Berkshire, England: 2.
- Ahmed, M. T. and S. M. Ismail (1995). "Residues of methomyl in strawberries, tomatoes and cucumbers." *Pesticide science* 44(2): 197-199.
- Andersen, J. H. and M. E. Poulsen (2001). "Results from the monitoring of pesticide residues in fruit and vegetables on the Danish market,

- 1998? 99." *Food Additives & Contaminants* 18(10): 906-931.
- Antonio, B. and J. Manuela (1995). "Occurrence of organochlorine agrochemicals residues in Spanish cheese." *Pestic. Chem* 44: 177-182.
- Camoni IV, I., R. Fabbrini, L. Attias, A. D. Muccio, E. Cecere, A. Consolino and F. Roberti (2001). "Estimation of dietary intake of pesticide residues by the Italian population during 1997." *Food Additives & Contaminants* 18(10): 932-936.
- Constenla, M. A., D. Riley, S. H. Kennedy, C. E. Rojas, L. E. Mora and J. E. Stevens (1990). "Paraquat behavior in Costa Rican soils and residues in coffee." *Journal of Agricultural and Food Chemistry* 38(10): 1985-1988.
- Epa, U. (1993). Re-registration eligibility decision (RED): glyphosate, EPA 738-R-93-014. US Environmental Protection Agency, Office of Pesticide
- Grandjean, P. and P. J. Landrigan (2006). "Developmental neurotoxicity of industrial chemicals." *The Lancet* 368(9553): 2167-2178.
- Kinyamu, J., L. Kanja, J. Skaare and T. Maitho (1998). "Levels of organochlorine pesticides residues in milk of urban mothers in Kenya." *Bulletin of environmental contamination and toxicology* 60(5): 732-738.
- Osfor, M., A. A. El Wahab and S. El Dessouki (1998). "Occurrence of pesticides in fish tissues, water and soil sediment from Manzala Lake and River Nile." *Food/Nahrung* 42(01): 39-41.
- Rai, M., J. V. Das and V. Gupta (1997). "A sensitive determination of paraquat by spectrophotometry." *Talanta* 45(2): 343-348.
- Rusibamayila, C., J. Ak'Habuhaya and M. Lodenius (1998). "Determination of pesticide residues in some major food crops of Northern Tanzania." *Journal of Environmental Science & Health Part B* 33(4): 399-409.
- Selisker, M. Y., D. P. Herzog, R. D. Erber, J. R. Fleeker and J. Itak (1995). "Determination of paraquat in fruits and vegetables by a magnetic particle based enzyme-linked immunosorbent assay." *Journal of Agricultural and Food Chemistry* 43(2): 544-547.
- Van Emon, J., J. Seiber and B. Hammock (1987). "Application of an enzyme-linked immunosorbent assay (ELISA) to determine paraquat residues in milk, beef, and potatoes." *Bull Environ Contam Toxicol* 39(3): 490-497.
- Wigfield, Y. Y., K. A. McCormack and R. Grant (1993). "Simultaneous determination of residues of paraquat and diquat in potatoes using high-performance capillary electrophoresis with a ultraviolet detection." *Journal of Agricultural and Food Chemistry* 41(12): 2315-2318.