

# ANALYTICAL EVALUATION OF PESTICIDE RESIDUES IN BIOTA WITHIN GBOKO LOCAL GOVERNMENT AREA, BENUE STATE

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## ABSTRACT

*The aim of this research was to assess the level of pesticide residues in biota (three staple vegetables) commonly cultivated in gboko. Telfairia occidentalis (fluted pumpkin), Talinum fruticosum (waterleaf) and Vernonia amygdalina (bitter leaf), were collected from three selected farms in gboko, Benue state. The vegetables were analysed for the presence of three pesticides (Relisate, weed crusher and reliquat) using UV-visible spectrophotometer. The results of the pesticide residues analysis revealed that fluted pumpkin leaves and waterleaf contains all the pesticides analysed at different concentration of 1.30, 0.343, 0.117 mol/l respectively and 1.30, 0.822, 0.617 mol/l respectively. The analysis indicates that, Bitter leaf contains only two pesticides: weed crusher; 0.051 mol/l and reliquat; 0.069 mol/l while Relisate was below detection. Also, all the pesticide residues were non-compliant with the FAO/WHO and CNH MRL standard for leafy vegetables; 0.07 and 0.2 mg/kg. This implies that continuous monitoring and education of farmers about proper use of pesticides is necessary. The evaluation and determination of water quality in biota within Gboko Local Government area of Benue State have provided valuable insight into the current aquatic ecosystem. The various parameters analysed show that, the PH for four samples collected are, sample A 6.76, (30.20c), sample B=6.45(30.30c), Sample C, 6.56(30.40c), Sample D=5.91 (30.70C). The total dissolved solid (TDS) were Sample A, 374PPM, Sample B, 125PPM, Sample C, 107PPM, Sample D, 47PPM. The chloride concentration were, Sample A=0.0465mol/l, Sample B=0.025mol/l, Sample C=0.043mol/l, Sample D=0.0265mol/l. The total suspended solid (TSS) were, Sample A, 8.55x10<sup>-10</sup>mg/l, Sample B, 6.85x10<sup>-10</sup>mg/l, Sample C=1.4x10<sup>-10</sup>mg/l, Sample D=8.7x10<sup>-10</sup>mg/l. The total solid (TS) were: Sample A=4.450mg/l, Sample B=35.145mg/l, Sample C=8.950mg/l, Sample D=170mg/l. The phosphate concentration was: Sample A=0.25mg/l, Sample B=11.28mg/l, Sample C=3.8mg/l, Sample D=6mg/l. The sulphate concentrations were: Sample A=33.9mg/l, Sample B=30.4mg/l, Sample C=24.86mg/l, Sample D=26.62mg/l. The overall results of this study highlight the current state of water quality in Gboko local government area of Benue State. The variation observed in the measured parameter indicates the presence of potential challenge to water quality in the standard ecosystem.*

**Keyword:** Pesticides, Biota, Organochlorine pesticides and Vegetable.

## INTRODUCTION

As the world population continues to grow, there is need for sustainable agricultural development to meet human demands for food. This brought about the increase in the use of pesticides to increase crop yield (Alyssa, 2013). Pesticides are agrochemicals that are used for crop protection.

There are two categories of pesticides: first-generation pesticides, which were used prior to 1940, consisted of compounds such as arsenic, mercury, and lead. These were soon abandoned because they were highly toxic and ineffective. second-generation pesticides were composed of synthetic organic compounds such as DDTaldrin, dieldrin, endrin, chlordane, parathion, captan and 2,4-D (Miller, 2004). Those pesticides were widely used due to its effective pest control.

In current agricultural practices, pesticides are broadly used on crops for pre and post harvest applications. Various well-known groups of pesticides are herbicides, insecticides, rodenticides, biopesticides and weedicides (Gilden *et al.*, 2010). Pests are disease causing organisms that use plants as their source of food. Pesticides are chemical substances intended for attracting, seducing and destroying, or extenuating any pest (USEPA, 2007).

Pesticide residues refer to the pesticides and its degradation products that may remain in the environment for a long time before its complete mineralization if all. Exposure of to these residues most commonly occurs through consumption of treated food sources, or being in close contact to areas treated with pesticides such as farms or lawns around houses. Many of these chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulation which could build up to harmful levels in the body as well as in the environment. Persistent chemicals can be magnified through the food chain and have been detected in products ranging from meat, poultry, and fish, to vegetable oils, nuts, and various fruits and vegetables (Crinnion, 2009).

A survey of pesticides indicates that a wide variety of them across different chemical classes have been deployed, especially for agricultural purpose along River Benue. Ekirigwe *et al.* (2015) determined the concentration of some organochlorine pesticides residues in River Benue water using Gas chromatograph, equipped with electron capture detector (ECD). Preliminary pesticide survey in Makurdi metropolis reveals that these pesticides  $\delta$ -BHC, chlorothalonil, endosulphan sulphate, heptachlor, lambda cyhalothrin, lindane, permethrin, P'P-DDT, were widely distributed at the various locations. Some of the pesticides of interest in this study among others include cypermethrin ( $\alpha$ -cyano-3-phenoxybenzyl-2,2-dimethyl-3-(2,2-dichlorovinyl) cyclopropanecarboylate), butachlor, aldrin, dieldrin, pendimethalin and propanil and  $\alpha$ -HCH. Cypermethrin belongs to a class of pesticides known as synthetic pyrethroid and it is generally used in combating insects in commercial agricultural practice. It is also used in consumer products for subsistence purposes (FAO, 2017). Ectoparasites of cattle, sheep, and poultry are sufficiently controlled by the application of cypermethrin (Hutson and Stoydin, 1987). Aldrin as an organochlorine insecticide that is still in use till now in Nigeria. Dieldrin is an organochloride originally produced as an insecticide in 1948. Alpha-Hexachlorocyclohexane ( $\alpha$ -HCH) is also an organochloride which is one of the isomers of hexachlorocyclohexane (HCH) (Hutson and Stoydin, 1987). It results from the production of lindane ( $\gamma$ -HCH) and it is still contained in commercial grade lindane which is used as insecticide. Lindane. United States has stopped the use of lindane for more than 20 years (Croucher *et al.*, 1985). Lindane is a white, powdery solid substance, stable at ambient temperatures. The Stockholm Convention on Persistent Organic Pollutants classified ( $\alpha$ -

HCH) and ( $\beta$ -HCH) as Persistent organic pollutants (POPs), since 2009 due to the chemical's ability to remain for a long time in the environment, bio-accumulative, biomagnifying, and long-range transport capacity. A several organophosphorous pesticides are extremely poisonous to human and animal life, placing the detection of residual organophosphorous pesticides an increasing concern (Chaoying *et al.*, 2007).

**Extraction Methods of Pesticide Residues:** The method of liquid-liquid extraction has been used for organophosphorous pesticide residues in environmental waters in which a nitrogen-phosphorus detector (NPD) was used to selectively detect trace amounts of organophosphates in the water. This is a method also developed by the Chinese Ministry of the Environment, regarded as Method GB 5750.9-2006 (Chaoying *et al.*, 2007). The method principally makes use of liquid-liquid extraction (LLE) to eliminate the residues but automated SPE can replace the use of LLE to reduce the quantity of organic solvent. There are various methods which have evolved in extraction of pesticide residues in both soil and food crops. Some of these are chromatographic methods used for either organophosphates or organochlorine pesticide analysis. The chromatographic methods for OP pesticides analysis include some of the promising techniques: solid-phase extraction, solid-phase micro-extraction, stir-bar sorptive extraction, matrix solid-phase dispersion, solvent extraction, liquid-phase micro-extraction, super critical fluid extraction, ultra-sonication extraction, microwave-accelerated extraction, and membrane-assisted methods, applied to various matrices (Picó *et al.*, 2007; Hyötyläinen and Riekkola, 2008; Wang and Du, 2010). Solid phase extraction (SPE) is one of the most commonly used sorbent techniques in analyzing pesticide residues. It is easy to operate, less costly; it is being automated and uses small amounts of solvent (Stoytcheva and Zlatev, 2011).

### **Determination of Pesticides Concentration**

Concentration of pesticides in different matrices can be adequately determined by several methods like chromatographic, electrochemical, immunochemical and biosensors analytical methods. Gas chromatography (GC) and carbon fibre micro electron (CFM) have been used for selected organochlorine determination (Wang and Li, 2008). Organophosphorus pesticides can be analysed by the application of several chromatographic methods such as gas chromatography-mass spectrometry, gas chromatography-tandem mass spectrometry, gas chromatography-ion trap mass spectrometry, gas chromatography time-of-flight mass spectrometry, high performance liquid chromatography etc (Wang *et al.*, 2011).

### **Effects of Pesticides on the Environment**

The environmental impact of pesticides consists of the effects of pesticides on non-target species. Over 98 % of sprayed insecticides and 95 % of herbicides reach a destination other than their target species, because they are sprayed or spread across entire agricultural fields (Miller, 2004). Each pesticide comes with specific set of environmental concerns, the effects of which have led many pesticides to be banned, while regulations have limited or reduced the use of others. Over time, pesticides have generally become less persistent and more species-specific. However, the global spread of pesticide use, including the use of obsolete pesticides that have been banned in some developed countries has overall increased (Lamberth *et al.*, 2013).

Many of the chemicals used in pesticides are persistent soil contaminants, whose impact may endure for decades and adversely affect soil conservation (US/EPA, 2007) The use of pesticides decreases the general biodiversity in the soil resulting in lower soil quality

(Johnston, 1986) with the additional effect that less organic matter in the soil allows for lower water retention (Kellogg et al., 2000). This decreases yields for farms in drought years, when organic farms have had yields 20-40% higher than their conventional counterparts (Lotter et al., 2003). A smaller content of organic matter in the soil increases the amount of pesticide that will not stay in the area of application because organic matter binds to and helps break down pesticides (Kellogg et al., 2000). Degradation and sorption are both factors which influence the persistence of pesticides in soil. Depending on the chemical nature of the pesticide, such processes control directly the transportation from soil to water, and in turn to air and food (Kellogg et al., 2000).

Nitrogen fixation which is required for the growth of higher plants, is hindered by pesticides in soil (Manuel et al., 2008). Pesticides kill bees and are strongly implicated in pollinator decline, and the loss of species that pollinate plants. Application of pesticides to crops that are in bloom can kill honeybees, which act as pollinators. The USDA estimate that US farmers lose at least \$200 million a year from reduced crop pollination because pesticides applied to fields eliminate about a fifth of honeybee colonies in the US and harm an additional 15 % (Miller, 2004). On the other side, pesticides have some direct harmful effect on plants including poor root hair development, shoot yellowing and reduced plant growth (Walley et al., 2006).

According to Liroff (2000), chlorinated hydrocarbons could pollute the tissues of virtually every life form on the earth, the air, the lakes and the oceans, the fishes that live in them and the birds that feed on the fishes. It has been found that atrazine, a popular weed killer feminize frogs, leading to sterility. About 80 million pounds of atrazine is used by farmers annually all over the world except in the EU countries where it has been banned since 2004.

Crisp et al (1998), reported that certain environmental chemicals including pesticides termed as endocrine disruptors are known to elicit their adverse effects by mimicking or antagonizing natural hormones in the body and it has been postulated that their long-term, low-dose exposure are increasingly linked to human health effects such as immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer.

Pesticides can enter the body through inhalation of aerosols, dust and vapor that contain pesticides; through oral exposure by consuming food/water; and through skin exposure by direct contact. The effects of pesticides on human health depend on the toxicity of the chemical and the length and magnitude of exposure (Lorenz, 2009). Farm workers and their families experience the greatest exposure to agricultural pesticides through direct contact.

Pesticides that are sprayed can move through the air and may eventually end up in other parts of the environment, such as soil or water. Pesticides that are applied directly to the soil may be washed off the soil into nearby bodies of surface water or may percolate through the soil to lower layers and ground water (Harrison, 1990). Some pesticides, including aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex and toxaphene, are considered persistent organic chemicals (POPs). They are compounds that resist degradation and thus remain in the environment for years. Some POPs have the ability to volatilize and travel great distances through the atmosphere to become deposited in remote regions. Such chemicals may have the ability to bioaccumulate, biomagnify and bioconcentrate up to 70,000 times their original concentrations. POPs can affect non- target organisms in the environment and increase risk to humans by disruption in the endocrine, reproductive, and immune systems (Ritter et al., 1995).

## Factors Influencing the Level of Pesticide Residues in Plants

The nature of pesticide residues in plants can be influenced by: adsorption, distribution, metabolism and elimination processes.

**Absorption** Sterling, in 1994 concludes that most herbicides are absorbed by plant cells by passive diffusion; however, examples are also given where the evidence suggests that some herbicides, dalapon, 2,4-D, glyphosate and paraquat are absorbed through active transport mechanisms. It is also concluded that weakly acidic herbicides can reach a higher concentration in the cell than that on the outside due to ion trapping in the alkaline components of the cell, the cytoplasm has a pH of approximately 7.5. Weakly basic herbicides are described as accumulating in the more acidic cell compartments such as the vacuole, pH 5.5. The physicochemical properties influencing absorption are lipophilicity, acidity, the cell membrane and the electrochemical potential in the cell.

The uptake of a xenobiotic (a foreign compound in a biological system) by the crop, following a pesticide treatment, depends on the degree of exposure from both the roots and aerial parts of the plant (Hamilton and Crossley, 2004). Pesticides on the surface of the plant or in the soil will be subject to a range of environmental factors, e.g. photolysis and microbial activity, which can result in degradation of the pesticide. These degradation products and the parent pesticide are therefore available for absorption. A further factor influencing the uptake of xenobiotics from the soil is the interaction of chemicals with the soil (Hamilton and Crossley, 2004). To be absorbed into the roots the xenobiotic needs to be bioavailable or present in the soil–water compartment, a function of the interactions of the chemical with soil organic matter or clay particles. This interaction is measured as the adsorption coefficient,  $K_d$  or  $K_{oc}$ , and in most cases shows some reversibility (Hamilton and Crossley, 2004). The uptake of compounds by the roots is therefore a factor of the soil adsorption coefficient of the xenobiotic, the concentration gradient between the soil solution and that inside the root, lipophilicity, degree of ionization, and on the mass flow of water. Aerial parts of the plant, i.e. the outer surfaces of the leaf and stem, have layers of cuticular wax above the cell walls which serves as a barrier to water loss and to the entry of xenobiotic compounds (Hamilton and Crossley 2004).

Fantke et al (2013) studied the evolution of pesticide residues in crop components harvested for human consumption by taking wheat grains as example. Results show that grain surface and soil are the compartments predominantly influencing the mass evolution of most pesticides in the plant–environment system. Additional influences are associated with substance molecular weight and time span between pesticide application and crop harvest. The uptake and persistence behaviour of the insecticide imidacloprid in tomato plants treated by foliar spray application and soil irrigation was also studied.

**Distribution** Plants have an effective transport system that uses a collection of vascular conduits, xylem and phloem, to distribute nutrients, water and assimilates. The flow within these vascular tissues is driven by differences in water potential and osmotic gradients (Hamilton and Crossley, 2004).

The translocation of xenobiotics within these vascular systems depends on the entry into the system and retention of the compound in the conduits for a sufficient time for them to be transported to other plant tissues. Transport in the xylem depends on the ability of the xenobiotic to be absorbed and on its partitioning behaviour (Briggs et al., 1982). Xenobiotic compounds transported in the xylem will be accumulated at the leaf tip and leaf margins, the

extremities of the water flow (Hamilton and Crossley, 2004). A pesticide may be chemically changed during absorption or distribution by enzymes within the plant cells. Any changes are likely to impact the physicochemical characteristics and hence its distribution throughout the plant, e.g. a non-ionized lipophilic compound may enter a plant cell and be conjugated, thus increasing its polarity and hence its ability to diffuse out of the cell (Hamilton and Crossley, 2004).

**Metabolism** ‘Metabolism’ in plants refers to processes forming products from chemical reactions on the plant surfaces. These include hydrolysis and photolysis, biological processes which occur outside of the plant like microbiological degradation in soil and biotransformations of the pesticide or any of the degradation products. The formation of photoproducts can be a significant issue in the definition of the residue of concern and may require specific toxicology testing to assess their relevance and analysis of the crop commodities to determine their significance (Hamilton and Crossley, 2004).

The metabolizing capability of plants has been shown in many occasions to be similar to animals with some differences around the catabolism of specific conjugates. Cole(1994) went so far as to describe the xenobiotic metabolism in plants as resembling that found in the animal liver based on metabolic patterns and enzyme classes and proposed the ‘green liver’ concept. The capability of a plant to metabolize a xenobiotic can be influenced by its growth stage at the time of application. It has been shown that the levels of glutathione enzymes were higher in young leaves, which would facilitate the levels of metabolism (Hatton et al., 1996).

**Elimination** Although plants do not have a classical excretory system, they do effectively eliminate xenobiotic compounds by removing them from active cell processes. They also remove them by storing them in the cell vacuole, (Cole, 1994), by reaction with the structural compartments of the plant, by exudation from the roots into the soil, or through volatilization. Pesticide residues eliminated from cell processes by reaction with lignin and cellulose represent bound residues and require specific assessment of their relevance during risk assessment (Hamilton and Crossley, 2004).

## **MATERIALS AND METHODS**

### **Sample Collection**

Survey was conducted to determine the types of pesticides used by farmers in the study area. Information was obtained from the State vegetable farmers and pesticide vendors. The samples used for this research were fluted pumpkin leaves (*telfairia occidentalis*), water leaves (*Talinum fruticosum*), and bitter leaves (*Vernonia amygdalina*). These vegetables were taken from three selected farmland in some areas in gboko local government area.

### **Instrumentation**

Absorption spectrum was performed on single beam spectrophotometer made by search tech-UV-visible spectrophotometer 752N with accuracy and Quartz Glasses used for analysis. PH measurement was performed with basic pH meter pH700 EUTECH instruments and centrifuge was used of REMI R- 4C.

### **Preparation of the Primary Stock Solution**

Analytical grade reagents were used for analysis and distilled deionised water was used for the experiments. The glass wares were cleaned randomly to remove the contamination. A

stock solution of weed crusher, reliquat and Relisate were prepared by dissolving 1 ml in acetate buffer (PH 4.5).

### **Preparation of Solvents**

A stock solution of acetate buffer (pH 4.5) was prepared by dissolving 34 gm of sodium acetate in 200ml of distilled water in acetic acid.

Alcoholic Potassium hydroxide of 2% was prepared. Hydrogen peroxide 2% w/v was prepared with 1M hydrochloric acid. Pyridine solution was prepared by adding 18ml of pyridine in 3ml of concentrated hydrochloric acid followed by 12ml of distilled water.

### **Preparation of Pesticide for Uv-spectrophotometric analysis**

An aliquot of 0.8ml of relisate, weed crusher and reliquat were taken using a 5ml syringe in 25ml graduated tube and 3ml of 2% alcoholic potassium hydroxide was added and then allowed to stand for 15 minutes for complete hydrolysis with potassium hydroxide. 0.5 ml of hydrogen peroxide was added and shaken well for 5 minutes (Danger et al., 2011).

In resulting mixture, 0.5 ml of pyridine solution was added and was boiled for 10-15 minutes in water bath now the mixture were allowed to cool at room temperature. After cooling 0.5 ml of Ninhydrin was added and was allowed to cool for about 5 minutes for the complete colour development. The resulting bright yellow, light green and dark green colour complex were measured at 200nm, 450nm, 500nm respectively by UV visible spectrophotometer.

### **Extraction of the sample for Uv-spectrophotometric analysis**

The extraction of the vegetable sample was carried out by the method described by Tamrakar et al. (2012). 10gm of the samples were weighed. After weighing, the samples were washed thoroughly with distilled water and placed in a mortar and then grounded into a paste using a pestle. The paste was transferred into a conical flask with the help of a spatula. A small amount of 50% ethanol was added and shaken thoroughly. This process was to ensure that enough of the pesticide residues were dissolved. The procedure was repeated for the samples from different farmland and the mixture was filtered into a labelled tube before been centrifuged at a speed of 1000rpm for 10mins. The resulting filtrate was decanted into a tube using a pipette. The absorbance value and wavelength scan were taken using a Uv spectrophotometer at 200, 450 and 500nm for relisate, weed crusher and reliquat respectively.

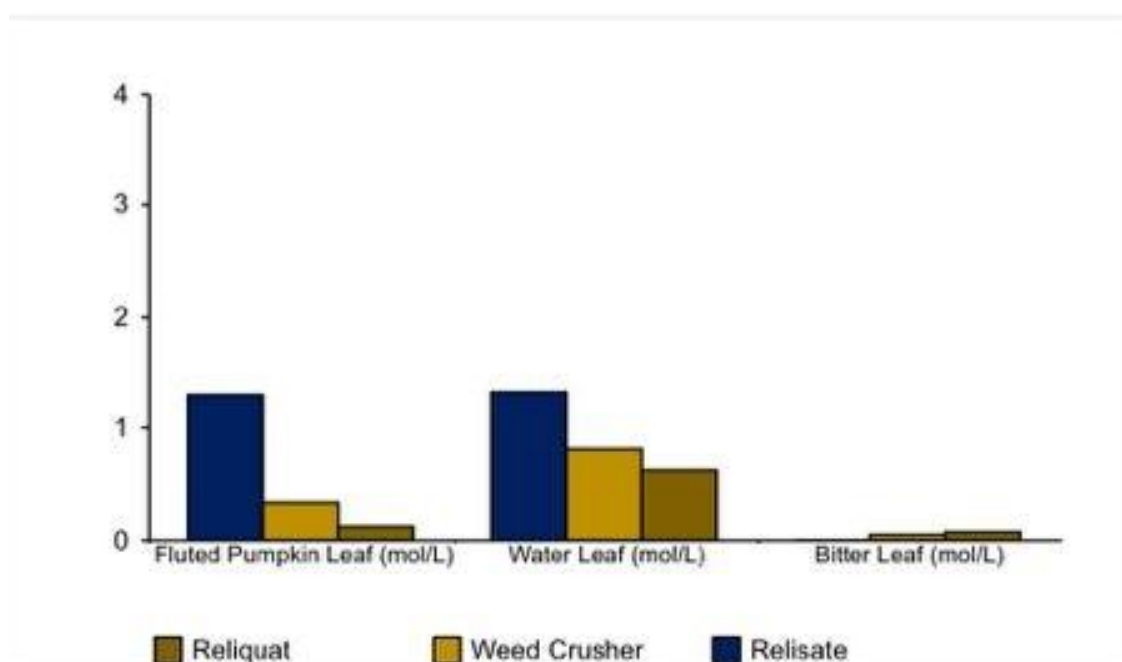
## **RESULTS**

### **Pesticide Residues in Vegetables**

The concentration of the detected pesticide residue in the vegetable sample is given in Table below:

**Table 1.0 Pesticide concentrations in fluted pumpkin, water leaf and bitter leaf.**

| Pesticides   | Vegetables                  |                    |                     |
|--------------|-----------------------------|--------------------|---------------------|
|              | Fluted Pumpkin Leaf (mol/L) | Water Leaf (mol/L) | Bitter Leaf (mol/L) |
| Relisate     | 1.300                       | 1.32               | ND                  |
| Weed Crusher | 0.343                       | 0.822              | 0.051               |
| Reliquat     | 0.117                       | 0.617              | 0.069               |



**Figure 1.0 level of pesticide residue on the vegetable samples**



**Table 2.0 Comparison of pesticide residue level with the maximum residue limit (FAO/WHO)**

| Sample         | Pesticide               | Pesticide residue concentration (mg/kg) | MRL(mg/kg) |
|----------------|-------------------------|---|------------|
| Fluted pumpkin | Relisate (glyphosate)   | 373.6                                   | 0.02       |
|                | Weed crusher (paraquat) | 79.70                                   | 0.07       |
|                | Reliquat (paraquat)     | 27.20                                   | 0.07       |
| Water leaf     | Relisate                | 379.9                                   | 0.02       |
|                | Weed crusher            | 191.4                                   | 0.07       |
|                | Reliquat                | 143.6                                   | 0.07       |
| Bitter leaf    | Relisate                | ND                                      | ND         |
|                | Weed crusher            | 11.90                                   | 0.07       |
|                | Reliquat                | 16.10                                   | 0.07       |

ND= not detected, if present it is below detection limits.

**Table 3.0 Comparison of Water Quality Parameter with World Health Standard**

The result of water quality parameter in the ecosystem under the studies is shown in the table below:

| Water quality parameters    | Tables                      |                             |                              |                              | WHS           |
|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|---------------|
|                             | A                           | B                           | C                            | D                            |               |
| pH                          | 6.76 (30.2°C)               | 6.45 (30.3°C)               | 6.56 (30.4°C)                | 5.9(30.7°C)                  | 6.5-8.5       |
| Total dissolved solid (TDS) | 374pp (30.2°C)              | 125ppm (30.2°C)             | 107ppm(30.6°C)               | 47ppm(30.7°C)                | 500ppm below  |
| Chloride (Cl <sup>-</sup> ) | 0.0465mol/L                 | 0.025 mol/L                 | 0.043 mol/L                  | 0.0265 mol/L                 | 250mg/l below |
| Total suspended solid (TSS) | 9.55x10 <sup>-10</sup> mg/L | 6.85x10 <sup>-10</sup> mg/L | 1.4 x 10 <sup>-10</sup> mg/L | 8.7 x 10 <sup>-10</sup> mg/L | 5mg/l below   |
| Total solid (TS)            | 4,450mg/L                   | 35,145 mg/L                 | 8,950 mg/L                   | 170 mg/L                     | 600mg/l below |
| Phosphate                   | 0.25mg/L                    | 11.28 mg/L                  | 3.8 mg/L                     | 6 mg/L                       | 1mg/l below   |
| Sulphate                    | 33.9 mg/L                   | 30.4 mg/L                   | 24.86 mg/L                   | 26.62 mg/L                   | 250mg/l below |

**Key:**

|          |   |   |
|----------|---|---|
| Sample A | = | Ipav Water                              |
| Sample B | = | Yandev Water                            |
| Sample C | = | Mbayion Water                           |
| Sample D | = | Mbyatiav Water                          |
| WHS      | = | World Health Standard for Water Quality |

**DISCUSSION**

This study investigated the presence of three pesticides: Relisate, weed crusher and reliquat that farmers used on fluted pumpkin, water leaf, bitter leaf commonly harvested in Okpokwu. Relisate, weed crusher and reliquat react with ninhydrin and give a bright yellow, light green and dark blue dye. The absorption spectrum of the dyes was measured at 200, 450 and 500 nm maximum absorbance by UV-visible spectrophotometer. All spectra measurements of the dye were performed against a double distilled water as a blank reagent negligible absorption spectrum at this wavelength. The obtained colour dye obeyed Beer's law limit range. The molar absorptive value were calculated 0.941,0.963 and 0.898L.mol/cm respectively. The level of Relisate in the three vegetable samples analyze are as shown in (Table 1.0). Relisate pesticide was not detected in all the vegetables. Only fluted pumpkin leaf and water leaf had some of the pesticide. The bitter leaf sample had none (below detection), this could mean that Relisate was not used in the cultivation process most likely non- chemical methods are been employed by the farmers to control weeds (PAN 2008).The concentration range of the

pesticide are 1.300 and 1.320mol/l. The level of Relisate was higher in water leaf. The level of weed crusher in the three vegetable samples analyzed as shown in Table 1.0. The samples contain various level of weed crusher, with water leaf having the highest value of 0.822mol/l, While flute pumpkin and bitter leaf having 0.343 and 0.051 mol/l respectively.

Table 1.0 shows the level of Reliquat in the three vegetable samples. Relisate was detected in all samples, with water leaf having the highest level 0.617mol/l. While fluted pumpkin leaf and bitter leaf having 0.117 and 0.069 mol/l.

The observed differences could be explained on the basis of different shape and morphology of these plants. The highest Paraquat (weed crusher and Relisate) level detected in water leaf could be attributed not only to the nature of its foliage system which could probably be responsible for the retention of this compound but also to the high fat content nature of the plant. Paraquat had been reported to be lipophobic, it is therefore not surprising to note that bitter leaf had the least amount of Paraquat residues. The differences may be attributed to the difference in the level of sensitivity.

The FAO/WHO Codex Alimentarius commission gave the maximum residue level (MRL) for paraquat on leafy vegetables as 0.07 mg/kg (FAO/WHO, 2006-2013). The vegetable samples had value above the MRL as shown in Table 1.0. The result from calls for concern since it well exceeded the WHO limit. This may be due to non-observance of certain recommended agricultural practices like respecting the safety interval between pesticide applications and harvest or using recommended rate of pesticide (Lee, 1998).

The CNH/FPC national food standard gave the maximum residue level for glyphosate on leafy vegetables as 0.2 mg/kg (CNH/FPC, 2014). The water leaf and fluted pumpkin leaf samples had values above the MRL as shown in Table 1.0.

The level of the herbicides concentration in root crops may not be unconnected with the farming practice which is mostly characterized with mixed cropping. In which case, the herbicides are used to control weeds when the tubers or these crops are already formed and almost matured for harvest, leading to absorption of the herbicides and their derivatives. Aside the residues accumulation in the crops already ripe for harvest, which tend to affect non-target organisms and potential public health threat to consumers of such crop products, inappropriate use of the herbicides could also result in the bushiness and stunting of the plants. This is observed in most crops exposed to higher concentration of herbicide applications (Weber 2018). The differential effects of herbicide could be attributed to their differential penetration through the root of the crops and absorption to the shoots and subsequently the accumulation in leaves which may be as a result of the degradation and detoxification within differently treated plants (WHO 2010). It is therefore very necessary to adhere to the precautions and guidelines required in handling and applying of herbicides in farmlands. This could be made possible through regular training of users as it will minimize injuries sustained by crop arising from inappropriate herbicide usage.

Overall, the results of this study highlight the current state of water quality in the Gboko Local Government Area of Benue State. The variations observed in the measured parameters indicate the presence of potential challenges to water quality in the studied ecosystem. The findings underscore the importance of monitoring and managing water quality to safeguard the health and integrity of the biota and their habitats.

The concentration of the pesticides residue in all the samples analyzed range from 1.32  $\mu\text{g}/\text{kg}$  to 6.36  $\mu\text{g}/\text{kg}$ .

### **Conclusion**

The vegetable samples which were collected and analyzed for pesticide residue within the period covered in the research were found to contain relatively high concentration of Relisate and weed crusher. The high concentration may be unconnected with the farming practice within the study area in which farmers are limited in skills and basic regulations needed in effective utilization of these chemicals in farm inputs. The level of pesticide residue overall was higher in waterleaf sample. Relisate (paraquat) was not found in bitter leaf sample that is, below the detectable limit. None of the vegetables sample shows pesticide residue below the maximum residue limit for leafy vegetables which indicates non-compliance and potential health risks. These result indicates that majority of growers using Agrochemicals is responsible for the residue levels in vegetables which is higher than the MRL and could pose health problems as these popular or common vegetable are consumed regularly by the population.

In summary, the utilization of a UV spectrophotometer in this project has provided valuable insights into the presence and level of pesticide residues in vegetables. The result highlight the importance of continuous monitoring and adherence to strict pesticide regulations to ensure consumers safety and minimize potential health risk associated with pesticide contaminated vegetables.

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