ANALYSIS OF THE COMPOSITION OF TWO LOCALLY MANUFACTURED PESTICIDES USED BY FISH TRADERS IN UYO, NIGERIA.

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ABSTRACT

The use of locally made chemical pesticides often exerts deleterious effects on man and his environment. In recent times, there has been an observed increase in the indiscriminate use of locally made chemical pesticides for the protection of food materials including fishes in Uyo metropolis. As a result, it has become necessary to analyze the composition of some locally made pesticides used by fish traders in Uyo metropolis, Akwa Ibom state, Nigeria. Test pesticides (“Diamond Knockdown” and “Best Fighter”) were purchased from traders in Uyo. The pesticides were subjected to physico-chemical, chemical composition and heavy metal analysis using High Performance Liquid Chromatography (HPLC), Mass Spectrometry (MS) and Atomic Absorption spectrophotometer. The two pesticides were found to be acidic, with a pH value of 3.6 for “Diamond Knockdown” and 3.8 for “Best Fighter”. Formaldehyde, isopropyl alcohol, camphor, dichlorvos (2,2-dichlorovinyl dimethyl phosphate) and naphthalene were detected in both pesticides. However, “Diamond Knockdown” had 1-hexene as one of the chemical constituents but it was not found in “Best Fighter” while Xylene was detected in “Best Fighter” but was absent in “Diamond Knockdown”. Dichlorvos had the highest chemical concentration for the two pesticides while formaldehyde had the lowest. Chromium, cadmium, mercury and lead were the heavy metals detected in concentrations of 0.012, 0.205, <0.001 and <0.001mg/l respectively for “Diamond Knockdown” while “Best Fighter” had 0.019, 0.039, <0.001 and <0.001mg/l concentrations respectively for chromium, cadmium, mercury and lead. The concentration of cadmium in “Diamond Knockdown” (0.205mg/l) slightly exceeded the World Health Organization (WHO) permissible limit (0.2mg/kg). Mercury and lead constituted the lowest amount (<0.001mg/l) of heavy metals for both pesticides. Repeated exposure to pesticides often results in bioaccumulation leading to deleterious effect on human health as well as the environment. Therefore, the indiscriminate manufacture and use of pesticides should be strongly discouraged and stiff penalties to offenders should be enforced.

Keywords: Analysis, Composition, Pesticide, Fish traders, Uyo.
INTRODUCTION

Adequate storage of agricultural products has become very imperative to enhance the contribution of agriculture to food security and survival (Sambo et al., 2016). In Southern Nigeria, insufficient and inadequate storage facilities in market places are some of the issues compromising the quality of food wares and these have resulted in high losses to farmers and traders (Ewah, 2011). Sambo et al. (2016) noted that a lack of developed infrastructure and storage facilities results in the wastage of cultivated crops and food products. The authors came to the conclusion that one of Nigeria’s biggest developmental setbacks is the unsolvable problem of inadequate infrastructure.

In some markets in Uyo, Akwa Ibom state Nigeria, fishes are kept by traders in dilapidated stores, with crevices, cracks and openings on the floors, openings between the door posts and the walls. In some market stores, very wide gaps exist between the door and the floor. These gaps are wide enough to allow access to stray animals like cats, dogs and also rodents like mice and rats and reptiles like lizards and a lot of cockroaches, flies and other insects. This often results in fish damage, spoilage, leading also to decreased value and substantial economic loss. Also, such fishes could become potential vectors of diseases.

From earliest times, fish traders have adopted various methods of preservation like smoking and drying (Tawari and Abowei, 2011). However, these methods do not solve the problems caused by storage of unsold fishes in dilapidated market stores. Recent measures adopted by some fish traders in markets in Uyo, Nigeria, is the use of cheap, locally manufactured chemical pesticides to protect their wares. This they do by spraying these pesticides on the bags/materials used in wrapping the fishes and on the exposed parts of fish support sticks and in some corners of the store using small dispensers. This is intended to scare away or even kill the animals.

In Akwa Ibom State, Nigeria, these local pesticides and repellents are produced indiscriminately and sold at several places, including but not limited to the markets, stores. They are also hawked along the streets and in cars, where public address systems are used to advertise their effectiveness as pesticides and repellents. These pesticides come in powder and liquid formulations and do not have any information on chemical composition, dosage and formulations, residue over time, National Agency for Food Drug Administration and Control (NAFDAC) registration number, place of manufacture and other facts that could caution their application. The only information displayed on the labels are the pictures of the target organisms such as the insects, reptiles, rodents etc. The labels are actually designed by printers and sold by other traders. They are only bought and pasted on the pesticide jars, bottles and dispensers, by the local manufacturers. Unfortunately, there is no consistency in the colour and nature of these pesticides and fish traders who use them may not be aware of their detrimental effects on human health and the environment. Fish consumers who cut across the different strata of the society in terms of educational and socio-economic status may not also be aware of these practices. Therefore, it is a public and environmental health concern.

Having confirmed the existence of unapproved locally synthesized chemical substances that are used as pesticides, and having confirmed that these chemicals are used secretly by fish traders in Uyo for the protection of dried fishes by fish traders during storage, this study was carried out to analyze the composition of two locally made pesticides (“Diamond Knockdown” and “Best Fighter”), used by fish traders in Uyo, Nigeria.

MATERIALS AND METHODS

Pesticides Used for this Study

The locally manufactured pesticides used for this study were “Diamond Knockdown” and “Best Fighter” (Figures 1a and 1b). They were purchased as liquid formulations in March 2018, from vendors at Akpan Andem, Anua, Itam and Use Offot Markets within Uyo Metropolis, Akwa Ibom State, Nigeria. They were preserved at 4OC in a refrigerator, prior to use. The labels on these pesticides had no information on their composition, active ingredients and place of
manufacture. None of them also had NAFDAC registration numbers and any instructions for use. The only information displayed on the labels were pictures of the target organisms (insects, reptiles, rodents).

**Figure 1a:** “Diamond Knockdown” Pesticide  
**Figure 1b:** “Best Fighter” Pesticide

**Determination of the Properties and Heavy Metals Composition of Test Pesticides**

The locally manufactured pesticides used for this study (“Diamond Knockdown” and “Best Fighter”) were screened for their physical properties, chemical constituents and heavy metal composition.

**Determination of Physical Properties**

Test pesticides (“Diamond Knockdown” and “Best Fighter”) were examined for physical properties such as colour, appearance, odour and clarity. This was done by physical examination of the test pesticides.

**Determination of the Chemical Composition of Test Pesticides**

Qualitative and quantitative analysis of these pesticides were carried out at the Global Research and Training Centre (SARL), Douala Cameroun (RC/DL N/2019/820). High Performance Liquid Chromatography (HPLC) and Mass Spectrometry (MS) were used for the separation, characterization and quantification of the pesticide analysis. The hydrogen ion concentration (pH), density at 25OC, viscosity, moisture content, non-volatile matter and ash content were determined by the use of devices such as pH meter for hydrogen ion concentration, hygrometer for density and viscometer for viscosity. Other parameters were determined as described by Ishiwu and Oluka, (2004). For instance, for the determination of total titratable acidity, a quantity of 10ml of each test pesticide was separately pipetted and introduced into a flask and stirred vigorously to remove carbon (IV) oxide (CO2). Each sample was then titrated with 0.1N standardized sodium hydroxide (NaOH). Phenolphthalein served as an indicator. The total titratable acidity was calculated as percentage citric acid. 1ml of the pesticides represented 0.0070g citric acid. The total titratable acidity (TTA) in percentage (%) is mathematically expressed by Ishiwu and Oluka (2004) as follows:

\[
TTA = \frac{M \times 0.0070g \times 100 \times N \times Vs}{100}
\]

Where M, N and Vs represent 0.1N NaOH used, normality and value/volume of pesticide sample used, respectively.
Determination of Heavy Metal Composition of the Test Pesticides

Heavy metal analysis of the pesticides was also carried out. This was done using the direct atomic absorption spectrophotometer (AAS Alpha series 4200). From the test pesticides (“Diamond Knockdown” and “Best Fighter”) aliquot samples were taken into 5ml universal testing tubes. The samples were filtered with a 1:1 Hydrochloric acid (HCL) and water and rinsed with distilled de-ionized water as described by Jamaluddin and Tasnima (2008). The samples were concentrated by evaporating 50ml of the pesticide sample to 1ml followed by the addition of 1ml of concentrated HCL and digested.

RESULTS

Physicochemical Properties of Test Pesticides

Results of the physicochemical properties of the test pesticides (“Diamond Knockdown” and “Best Fighter”) are presented in Table 1.

Other Chemical Constituents of the Test Pesticides

Qualitative and quantitative analysis of the pesticide, “Diamond Knockdown” using HPLC and MS revealed the presence of the chemical compounds; formaldehyde, 1-hexene, Isopropyl alcohol, Camphor, dichlorvos (2, 2-dichlorovony 1-dimethylphosphate) and naphthalene in different proportions. This is presented in figure 2 and table 2.

Chemical Composition of “Best Fighter”

High Performance Liquid Chromatography (HPLC) and Mass Spectrometry (MS) analysis of “Best Fighter” pesticide revealed the presence of formaldehyde, xylene, Isopropyl alcohol, camphor, dichlorvos and naphthalene, also in different proportions. This is presented in figure 3 and table 3.

Heavy Metal Composition of Test Pesticides

Table 4 shows the heavy metal composition of “Diamond Knockdown” and “Best Fighter” pesticides. Chromium (Cr), Cadmium (Cd), Mercury (Hg) and Lead (Pb) were detected in the test pesticides. The heavy metals detected were also present in different concentrations in the pesticides.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Parameters</th>
<th>“Diamond Knockdown”</th>
<th>“Best Fighter”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Appearance/colour</td>
<td>Deep Yellow</td>
<td>Yellowish Red</td>
</tr>
<tr>
<td>2</td>
<td>Odour</td>
<td>Pungent</td>
<td>Pungent</td>
</tr>
<tr>
<td>3</td>
<td>Clarity</td>
<td>Clear</td>
<td>Clear</td>
</tr>
<tr>
<td>4</td>
<td>pH (undiluted)</td>
<td>3.6</td>
<td>3.8</td>
</tr>
<tr>
<td>5</td>
<td>Density at 25°C</td>
<td>1.08g/ml</td>
<td>1.04g/ml</td>
</tr>
<tr>
<td>6</td>
<td>Viscosity (cps)</td>
<td>3.1</td>
<td>2.3</td>
</tr>
<tr>
<td>7</td>
<td>Moisture/volatile content %</td>
<td>23.4</td>
<td>20.3</td>
</tr>
<tr>
<td>8</td>
<td>Non-volatile matter %</td>
<td>75.6</td>
<td>99.5</td>
</tr>
<tr>
<td>9</td>
<td>Ash content %</td>
<td>0.13</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>Acidity (as Citric Acid)</td>
<td>74.3ppm</td>
<td>72.8ppm</td>
</tr>
</tbody>
</table>

Table 1: Physiochemical Profile of “Diamond Knockdown” and “Best Fighter” Pesticides

pH- Hydrogen ion potential
cps- Cycles per second
Table 2 Chemical Composition of Diamond Knockdown

<table>
<thead>
<tr>
<th>S/N</th>
<th>Component Name</th>
<th>Formular</th>
<th>Concentration (mg/ml)</th>
<th>Retention index</th>
<th>Retention Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formaldehyde</td>
<td>CH₂O</td>
<td>0.426</td>
<td>370</td>
<td>11.30</td>
</tr>
<tr>
<td>2</td>
<td>I-Hexene</td>
<td>C₆H₁₂</td>
<td>1.481</td>
<td>674</td>
<td>6.09</td>
</tr>
<tr>
<td>3</td>
<td>Isopropyl alcohol</td>
<td>C₃H₈O</td>
<td>2.042</td>
<td>600</td>
<td>3.12</td>
</tr>
<tr>
<td>4</td>
<td>Camphor</td>
<td>C₁₀H₁₆O</td>
<td>4.500</td>
<td>300</td>
<td>16.84</td>
</tr>
<tr>
<td>5</td>
<td>Dichlorvos (2, 2 – dichlorvonyl –dimethyl. phosphate)</td>
<td>C₄H₇CL₂O₄P</td>
<td>8.306</td>
<td>2456</td>
<td>14.64</td>
</tr>
<tr>
<td>6</td>
<td>Naphatalene</td>
<td>C₁₀H₈</td>
<td>5.414</td>
<td>704</td>
<td>10.31</td>
</tr>
</tbody>
</table>

Figure 2: Chemical Composition of “Diamond Knockdown” Pesticide

Figure 3: Chemical composition of “Best Fighter” pesticides
Table 3: Chemical composition of “Best Fighter”

<table>
<thead>
<tr>
<th>Peak No.</th>
<th>Component Name</th>
<th>Formula</th>
<th>Concentration (mg/ml)</th>
<th>Retention Index</th>
<th>Retention Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formaldehyde</td>
<td>CH₂O</td>
<td>0.418</td>
<td>235</td>
<td>13.33</td>
</tr>
<tr>
<td>2</td>
<td>Xylene</td>
<td>C₈H₁₀</td>
<td>1.462</td>
<td>576</td>
<td>5.08</td>
</tr>
<tr>
<td>3</td>
<td>Isopropyl alcohol</td>
<td>C₃H₈O</td>
<td>2.035</td>
<td>450</td>
<td>7.42</td>
</tr>
<tr>
<td>4</td>
<td>Camphor</td>
<td>C₁₀H₁₆O</td>
<td>4.500</td>
<td>215</td>
<td>13.56</td>
</tr>
<tr>
<td>5</td>
<td>Dichlorvos (2,2-dichlorovinyl dimethyl phosphate)</td>
<td>C₄H₇Cl₂O₄P</td>
<td>8.306</td>
<td>2350</td>
<td>18.42</td>
</tr>
<tr>
<td>6</td>
<td>Naphthalene</td>
<td>C₁₀H₈</td>
<td>5.414</td>
<td>600</td>
<td>9.35</td>
</tr>
</tbody>
</table>

Table 4: Heavy Metal Composition of “Diamond Knockdown” and “Best Fighter”

<table>
<thead>
<tr>
<th>Parameters</th>
<th>DK</th>
<th>BF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium (Cr)</td>
<td>0.012 (mg/l)</td>
<td>0.019 (mg/l)</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.205 (mg/l)</td>
<td>0.039 (mg/l)</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>&lt;0.001 (mg/l)</td>
<td>&lt;0.001 (mg/l)</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>&lt;0.001 (mg/l)</td>
<td>0.001 (mg/l)</td>
</tr>
</tbody>
</table>

DK- “Diamond Knockdown”  
BF- “Best Fighter”

DISCUSSION
Deteriorating market infrastructure and lack of adequate storage facilities remain a challenge in most parts of Nigeria. This has led the traders to adopt various protective measures for their wares including food stuffs. Some of these protective measures are unhealthy to both humans and the environment (Onyeaka et al., 2021). Injudicious use of locally manufactured pesticides and repellents to protect their wares from destruction by stray animals during storage is one of such harmful strategies (Khan and Ahmad, 2019). “Diamond Knockdown” and “Best Fighter” are among the locally manufactured pesticides used by fish traders in Uyo, Southern Nigeria for this purpose.

The pungent odour perceived in the test pesticides used in this research was unpleasant. Unpleasant odours are often annoying. Health related symptoms such as irritation of the mucus membrane, the eyes, nose and throat have been reported to be connected to odour annoyance (Clausen, 1998). Steniheider (1999) reported that odour in the environment could be a danger factor for health and wellbeing. The pH values of the two test pesticides indicated their acidity. Studies suggest that repeated exposure and or consumption of acidic substances could predispose the body to chronic metabolic acidosis, which could in turn result in some diseases such as hepatic failure on the long run (Baynes and Dominiczak, 2018). Also, diets high in acidic foods cause the body cells to breakdown prematurely and create acid bombs that circulate in the bloodstream to cause havoc in the body system (Jelang et al., 2019).
The chemicals and heavy metals that have been detected in the test pesticides (“Diamond Knockdown” and “Best Fighter”) have been reported to be deleterious to human and other mammalian health. As stated by Agency for Toxic Substance and Disease Registry (ATSDR), formaldehyde is a colourless, volatile, flammable gas that polymerizes easily gas and has a pungent odour (ATSDR, 2008). One of the routes through which formaldehyde can enter the human body is through the ingestion of formaldehyde in food and water (ATSDR, 2008). Predominant signs of short-term exposure to formaldehyde in humans are irritation of the eyes, nose and throat, concentration dependent discomfort, lachrymation, sneezing, coughing, nausea, and finally death (ATSDR, 2008). Formaldehyde has been shown to be toxic in vitro in a variety of experimental systems including human cells (ATSDR, 2008; Sapmaz et al., 2017). Also, cases of cancer have been reported for humans exposed to formaldehyde in workplace (ATSDR, 2008). Sapmaz et al. (2017) reported the harmful effects of formaldehyde on rats exposed to different doses of formaldehyde inhalation. They concluded that exposure to formaldehyde by inhalation induced cells death and tracheal epithelial damage in the experimental rats.

Isopropyl alcohol has been reported to cause headache, dizziness, nausea, vomiting, anesthetic effect, hypothermia, hypotension, shock, respiratory depression and coma (Slaughter et al., 2014). Exposure to this chemical is mainly by inhalation, ingestion and skin absorption (United States Environmental Protection Agency, 2014). Furthermore, Akingbade et al. (2017) observed testicular histological damage and deranged sperm parameters on adult Albino Wistar rats exposed to isopropyl alcohol-based air freshener.

The toxicity and health effects of camphor to both humans and animals, have been documented (Zuccarini and Soldani, 2009). The most common cause of camphor intoxication in humans, particularly children, is inadvertent ingestion (Sigel and Wason, 1986). Manoguerra et al. (2006) reported that more than one million (1,000,000) cases of exposure to camphor containing products were registered between 1990 and 2003. This led to a variety of symptoms, including ataxia, convulsion, lethargy, severe nausea, vomiting and coma (Manoguerra et al., 2006).

Chedi and Aliyu (2010) reported acute poisoning symptoms of urination, restlessness, pupil constriction, respiratory distress and convulsion of 2,2- dichlorovinyl dimethyl phosphate (dichlorvos) against albino wistar rats in Kano, Nigeria. Similarly, Ezeji et al. (2015) reported significant reduction in the level of testosterone in adult male rats fed with water contaminated with dichlorvos. Their study also revealed that there was distortion in the levels of seminiferous cells as well as an abnormal enlargement of the spermatogenic cells. Sisman (2010) reported the developmental effect of dichlorvos on Zebrafish. The study showed the developmental abnormalities such as lack of blood flow, cardiac edema, delayed hatching and vertebra malformation in embryo and larvae of Zebrafish exposed to dichlorvos. Ogunsola et al. (2019) reported that the chronic inhalational exposure to varying concentrations of dichlorvos over a period of 90 days induced histopathological changes in the heart, kidney and liver of albino wistar rats. They showed that these changes increased with increase in the concentration of the chemical and were mostly degenerative. Furthermore, vascular flow was altered including congestion and hemorrhages, and to a lesser extent inflammatory. The National Institute of Occupational Safety and Health (NIOSH, 2017) reported that occupational exposure to dichlorvos has potential to cause skin sensitization. A 2017 report by NIOSH showed that flower growers exposed to dichlorvos had dermatitis when human diagnostic patch test was carried out on them (NIOSH, 2017).

Naphthalene compounds which was detected in the two test pesticides, exist primarily as vapour and the toxicological and health effects of this compound have been well documented (Yost et al., 2021). According to the
Agency for Toxic Substances and Disease Registry (ATSDR), naphthalene exposure has been associated with cancer and non-cancer health effects with most of the evidence coming from animal and human case studies (ATSDR, 2005).

Acute inhalation of humans to I-hexene which was detected only in “Diamond Knockdown” has been reported to cause dizziness, giddiness, slight nausea and headache (ATSDR, 1997). Furthermore, chronic inhalational exposure to I-hexene has been associated with sensor motor polyneuropathy in humans with symptoms such as numbness, muscular weakness, blurred vision, headache and fatigue observed in extreme cases (United States Environmental Protection Agency, 1999). Also, U. S EPA, (1999) reported observed testicular damage in male rats exposed to I-hexene through inhalation. Xylene which was only detected in “Best Fighter” has been reported to be associated with depression of the central nervous system with symptoms such as headache, dizziness, nausea and vomiting (Naiz et al., 2015). Tarko et al. (2017) reported that xylene enhanced the production of Insulin Growth Factor 1 (IGF 1) and cellular multiplication. They proposed that xylene might cause cancerous changes that are typified by increased cell division. Also as reported by Tarko et al. (2018), exposure to xylene hindered the fundamental operations of the ovaries which include cell division, hormones production and apoptotic processes (a type of cell death). Using Holstein cows, the authors discovered that ovarian cells exposed to xylene in vitro may have problems releasing progesterone and testosterone.

The heavy metals detected in these test pesticides have all been reported to be toxic both to human and other mammalian body systems. Chromium that was detected in the test chemicals has been reported to cause a variety of diseases through bioaccumulation in human and animal tissues (Fang et al., 2014). The primary route of exposure of chromium to non-occupational human population is through ingestion of chromium contaminated food and water (Nickens et al., 2010). Some of the diseases caused by this heavy metal ranges from dermal, renal, neurological and gastrointestinal diseases to the development of several cancers including cancers of the lungs, larynx, bladder, kidney, testicles, bones and thyroid (Fang et al., 2014; Deng et al., 2019). Also Salama et al. (2016) reported a high risk of brain damage in Albino Wistar rats exposed to low doses of chromium through intranasal exposure.

Kumar and Sharma (2019) reported that low level exposure to cadmium may lead to damage of the kidneys, liver as well as skeletal and the cardiovascular systems. The authors further stressed that the exposure to this heavy metal can lead to the deterioration of sight and hearing. Humans can be exposed to cadmium upon consumption of cadmium tainted water and food. These exposures could result to the alteration of physiological mechanisms of the body leading to short or long-term disorders (Jiang et al., 2015; Richter et al., 2017; Cao et al., 2018). According to a study by Kim et al., (2020) on the exposure assessment and safe intake guidelines for heavy metals consumed in fishery products, cadmium has been classified as carcinogenic to humans by the International Agency for research on cancer (IAPC). De Francis et al. (2015) investigated fifty (50) healthy men and found that high concentration of cadmium in their blood was positively associated with a reduction of sperm motility and tetratozoospermia. Low level exposure of cadmium has been reported to have strong tetratogenic and mutagenic effects on humans and this adversely affects the male and female reproductive systems (Kumar and Sharma, 2019). Disorders of the menstrual cycle and reproductive hormones, steroidogenesis, delay in puberty and menarche, pregnancy loss, premature birth as well as reduced birth weight are all altered by cadmium (Geng and Wang, 2019; Kumar and Sharma, 2019). Borowska et al. (2017) reported that exposure of rats to 1 and 5mg/kg cadmium resulted in disorders which affected the metabolism of essential elements zinc and copper.
Contamination of food from natural sources and human activities, occupational exposure in agriculture and manufacturing sectors are the main routes of exposure to mercury (Azizullah et al., 2011). However, exposure may also occur through consumption of fish and shellfish contaminated with mercury through various routes such as artificial preservatives processes (Moriarity et al., 2020). Exposure to mercury and compounds of mercury have been reported to be harmful to man and other mammals (Noto, 2021). Health problems associated with mercury are most severe for developing fetus and for young children (Gormaz et al., 2014). Pregnant women that consume fish contaminated with large amount of mercury run the risk of their babies having unhealthy changes in their heart and blood vessels (Noto, 2021). Dos Santos et al. (2018) reported that infant with severe developmental disabilities were born from mercury poisoned pregnant women. In adults, accumulation of mercury in the blood can lead to problems in the central nervous system and possibly adversely affect the cardiovascular system (Noto, 2021). Akgul et al. (2016) reported that chronic exposure to mercury vapour can lead to renal injuries. In their investigation, they observed that Wistar rats exposed to 1mg/m3 mercury vapour per day had histological alteration of their kidneys after 45 days. In another study, Aragoa et al. (2018) demonstrated cognitive impairment and hippocampal damage in rats with oral chronic administration of mercury. The authors also found that mercury levels in the hippocampus increased to 0.04ug/g while the control group had mercury concentration less than 0.01ug/g.

Lead (Pb) exposure can have serious consequences for the health of humans especially children. Two million lives were lost globally to known chemical exposure in 2019 and nearly half of the two million lives lost were due to lead exposure (WHO, 2022). Also, according to a WHO (2022) report, high levels of exposure to lead attacks the brain and central nervous system, causing convulsions, coma and even death. Even at lower levels of exposure that causes no obvious symptoms, lead is known to produce spectrum of injuries across multiple body systems (WHO, 2022). Low level of exposure to lead can affect brain development in children often resulting in reduced intelligence quotient (IQ), behavioural changes such as reduced attention span, increased antisocial behaviour and reduced educational attainment (WHO, 2022). Exposure to lead also causes anaemia, hypertension, renal impairment, immunotoxicity and toxicity to reproductive organs. Lead is thought to have irreversible effects on the nervous system and behavior (WHO, 2022). According to a 2021 United States Centre for Disease Control (U.S CDC) report, blood lead concentration as low as 3.5ug/dl may be associated with decreased intelligence in children, behavioural difficulties and learning and as the lead exposure increases the range and severity of symptoms and effects also increase.

The results obtained from the characterization of the pesticides used in this study which revealed the presence of some chemical compounds and heavy metals is an issue of concern. Although Mass Spectrometry (MS) revealed that most of the heavy metals detected were within acceptable WHO limits (WHO, 2022), except cadmium which was only slightly higher in “Diamond Knockdown”, there is still the challenge of bioaccumulation and biomagnification of pesticides. Pesticides in food stuffs and the environment often find their way into biosystems resulting in their accumulation in organisms leading to lethal and sub lethal effects in humans and animals (Gupta and Gupta, 2020). The use of these pesticides should therefore be more regulated and properly licensed for safe use.

**CONCLUSION**

In recent times, the practice of using locally synthesized pesticides in food protection has been on the increase and these chemicals have been widely reported to be toxic to humans, animals and the environment. This study has
highlighted the possible dangers associated with the chemicals and heavy metals detected in the two locally manufactured pesticides used by fish traders in Uyo, for fish protection. The findings from this study revealed that based on the chemical and heavy metal composition of these locally manufactured chemicals used by fish traders in Uyo metropolis for fish protection, exposure of animals and humans to various concentrations of “Diamond Knockdown” and “Best Fighter” pesticides can lead to systemic disorder such as haematological, reproductive and histological disorders, biochemical defects, immunological compromise, environmental and toxicological effects in humans and animals. These chemicals and heavy metals are known to enter the body through different routes including drinking water, air, food, or occasionally dermal exposure. It is apparent that Nigeria suffers perishable agricultural losses due to inadequate storage facilities, a lack of infrastructure development and poorly maintained infrastructure. Therefore, better storage technologies and quick investment in market infrastructure development can help solve the issue of food losses. These will to a large extent reduce the over reliance on locally manufactured chemicals by farmers and traders to protect their goods during storage. Furthermore, government and her relevant agencies should enforce legislations on the ban of indiscriminate use of chemical pesticides and stiff penalties should be meted out to defaulters to discourage others from engaging in the practice.

COMPETING INTERESTS

Authors declare that they have no competing interests.

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REFERENCES


