ENTOMOTOXICITY AND CHEMICAL CHARACTERIZATION OF THE POWDERS AND OIL EXTRACTS OF ZANTHOXYLUM ZANTHOXYLOIDES AND ANACARDIUM OCCIDENTALE ON SITOPHILUS ORYZAE.

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INTRODUCTION

Sitophilus oryzae is a major rice storage insect pest that is primarily controlled with synthetic insecticides. Synthetic insecticides have been found to be flawed due to their negative effects on human health, the environment, and insect resistance, while safer alternatives are being considered. The toxicity of powders and oil extracts of *Zanthoxylum zanthoxyloides and Anacardium occidentale on S. oryzae,* as well as the chemical constituents of the oil extracts, were investigated in this study.

MATERIALS AND METHODS

- Fifty newly emerged adults of S. oryzae were reared on clean uninfested rice grains and served as the stock culture of the insects used for the insect bio-assay.
- The powder treatment was evaluated using concentrations of 1.0 g, 1.5 g, and 2.0 g, corresponding to 5%, 7.5%, and 10% (w/w) concentrations of *Z. zanthoxyloides* and *A. occidentale*, respectively. This was mixed with 20 g of clean, uncontaminated rice grains.
- Plant oil was extracted using the Soxhlet method of extraction technique, and the ethanolic extracts from *Z. zanthoxyloides* and *A. occidentale* were tested for toxicity against *S. oryzae* at 0.0625%, 0.125%, 0.25%, and 0.50% concentrations (Kemabonta and Falodu, 2013)
- The lethal dose was determined using Probit analysis
- Each of the treatments had a control setup and the experiment was arranged in three replicates in a completely randomized design, test sample size was ten(10).
- Gas chromatography–mass spectrometry (GC–MS) and Phytochemical analysis followed standard procedure (Olivia et al., 2021).
- Data were analyzed with the aid of Statistical Package for Social Science (SPSS) Version 23 and subjected to analysis of variance (ANOVA). The results were tested at 5 % level of significance and treatment means were separated using Duncan's post- hoc test.

RESULTS

The insect mortality results are shown in Tables 1 and 2 while the lethal dose LD_{50} and LD_{90} in Table 3. The constituents of the ethanolic extracts of the two botanicals is shown in Table 4 and 5. GC-MS Chromatogram is presented in Figures 1 and 2 respectively. The phytochemicals present in *Z. zanthoxyloides and A. occidentale* are listed in Table 6.

Table 1: Mortality rates of *S. oryzae* treated with the powders of *Z. zanthoxyloides* and *A. occidentale*

Powder Extract	Conc. (g)	24hrs Mean±S.E(%)	48hrs Mean±S.E(%)	72hrs Mean±S.E(%)	96hrs Mean±S.E(%)
Zanthoxylum zanthoxyloides	1.0	10.00±5.77^{a}	40.00±5.77^{b}	56.67±6.67^{bc}	80.00±10.00^{bc}
	1.5	20.00±11.55^{a}	50.00±15.28^{b}	73.33±14.53^{bc}	90.00±10.00^{bc}
	2.0	30.00±5.77^{a}	56.67±6.67^{b}	86.67±6.67^{c}	100.00±0.00^{c}
Anacardium occidentale	1.0	10.00±5.77^{a}	30.00±0.00^{a}	46.67±3.33^{b}	53.33±8.82^{b}
	1.5	13.33±6.67^{a}	33.33±3.33^{a}	53.33±3.33^{bc}	66.67±8.82^{bc}
	2.0	20.00±5.77^{a}	43.33±8.82^{b}	63.33±12.02^{bc}	80.00±15.28^{bc}
Control	0.0	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}

Each value is a mean ± standard error of three replicates. Means followed by the same letter among the treatments are not significantly different (p > 0.05) using Duncan's Test

Table 2: Mortality rates of *S. oryzae* treated with the oil of *Z. zanthoxyloides* and *A. occidentale*

Oil Extract	Conc.	24hrs Mean±S.E (%)	48hrs Mean±S.E(%)	72hrs Mean±S.E(%)	96hrs Mean.S.E(%)
Zanthoxylum zanthoxyloides	0.0625	40.00±5.77^{b}	56.67±3.33^{b}	66.67±3.33^{b}	73.33±6.67^{b}
	0.125	33.33±3.33^{ab}	53.33±3.33^{b}	66.67±3.33^{b}	83.33±8.82^{bc}
	0.250	43.33±6.67^{b}	60.00±5.77^{b}	83.33±3.33^{b}	93.33±3.33^{bc}
	0.50	33.33±6.67^{ab}	66.67±14.53^{b}	86.67±8.82^{b}	100.00±0.00^{c}
Anacardium occidentale	0.0625	43.33±8.82^{b}	60.00±5.77^{b}	70.00±0.00^{b}	83.33±6.67^{bc}
	0.125	50.00±15.28^{b}	63.33±14.53^{b}	83.33±8.82^{b}	90.00±5.77^{bc}
	0.250	53.33±8.82	66.67±6.67^{b}	80.00±10.00^{b}	96.67±3.33^{bc}
	0.50	53.33±6.67^{b}	73.33±8.82^{b}	90.00±10.00^{b}	100.00±0.00^{c}
Control	0.0	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}

Each value is a mean ± standard error of three replicates. Means followed by the same letter among the treatments are not significantly different (p > 0.05) using Duncan's Test

Table 3: Lethal Dose (LD_{50} and LD_{90}) of *Z. zanthoxyloides and A. occidentale* against *S. oryzae* of powders and oil at 96hours

Dose	*Z. Zanthoxyloides* (Powder)	*A. Occidentale* (Powder)	*Z. Zanthoxyloides* (Oil)	*A. Occidentale* (Oil)
LD_{50} (LCL - UCL)	0.663(0.052-0.909)	0.945(0.022-1.247)	0.031(0.003-0.056)	0.018(0.00-0.043)
LD_{90} (LCL - UCL)	1.309(1.015-2.112)	3.146(2.051-6144.5)	0.160(0.107-0.366)	0.105(0.044-0.228)
Probit Line of equation	Y=0.8+2.5X	Y=0+2.5X	Y=2.4571+1.4286X	Y=3.0286+1.7143X

Table 4: The major compounds identified in ethanolic extracts of *Zanthozylum zanthozyloides*; retention times (RT), formula and molecular weight (Mw)

S/N	Retention time	Proposed compound	Molecular formular	Molecular weight(g/mol)	Peak Area%
1	3.122	2-Furancarboxaldehyde,5-methyl-	C6H6O2	110.11	0.16
2	4.461	Orcinol	C7H8O2	124.14	0.30
3	4.638	Phenol,2-methocy-	C7H8O	124.14	2.16
4	4.941	Maltol	C6H6O3	126.11	0.16
5	5.325	4H-puran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	C6H8O	144.12	0.16
6	6.343	5-Hydroxymethylfurfural	C6H6O3	126.11	0.82
7	6.921	Hydroquinone	C6H6O2	110.11	0.82
8	7.396	2-methoxy-4-vinylphenol	C9H10O2	150.17	1.38
9	7.642	Piperonal	C8H6O3	159.17	1.02
10	7.814	Phenol, 2-methoxy-6-(1-propenyl)-	C8H10O3	154.16	1.65
11	8.369	Vanillin	C8H8O3	152.15	1.25
12	8.907	Phenol, 2-methoxy-6-(1-propenyl)-	C10H12O2	164.20	0.160
13	9.616	Benzoic acid, 4-hydroxy-3-methoxy-,methylester	C9H10O	182.17	0.28
14	10.789	beta.-D-Glucopyranose, 4-O-, beta.-D-galactopyranosyl-	C12H22O	342.30	0.17
15	11.029	Benzaldehyde, 4-hydroxy-3,5-dimethoxy-	C9H10O	182.17	0.82
16	11.396	€-2,6-Dimethixy-4-(pro-1-en-;yo)phenol	C11H14O3	194.23	0.25
17	11.750	4-[(IE)-3-Hydroxy-1-prpenyl]-2-methoxyphenol	C10H12O3	180.20	5.26
18	12.197	9,17-Octadecafienal,(Z)-	C18H32O	264.4.	0.16
19	13.410	2,4 Decadienamide, N-isobutyl-,(E, E)-	C14H25NO	223.35	3.78
20	13.776	Scoparone	C11H10O4	206.19	1.21

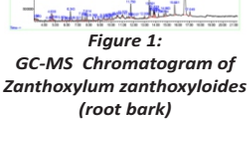

Figure 1:
GC-MS Chromatogram of Zanthoxylum zanthoxyloides (root bark)

Table 5: The major compounds identified in ethanolic extracts of *Anacardium occidentale*; retention times (RT), formula and molecular weight (Mw)

S/N	Retention time	Proposed compounds	Molecular formular	Molecular weight(g/mol)	Peak Area%
1	5.628	Benzoic acid, ethyl ester	C9H10O2	150.17	2.61
2	9.095	Cis -Vaccenic acid	C18H34O2	282.46	0.48
3	9.673	Benzoic, 4-ethoxy-,ethyl ester	C11H14O3	194.23	1.85
4	10.457	9-oxabicyclo(6.1.0)nonane,cis-	C8H14O	126.20	1.26
5	10.789	9,12-octadecadienoic acid (E, Z)-	C18H32O2	280.40	1.14
6	13.281	Hexadecanoic acid, methyl ester	C17H34O	270.45	7.81
7	13.833	Hexadecanoicacid, ethyl ester	C18H36O2	280.50	16.52
8	15.189	€-9-Octadecanoic acid ethyl ester	C20H38O2	310.50	26.31
9	15.378	Octadecanoic acid, ethyl ester	C20H40O2	312.53	28.08

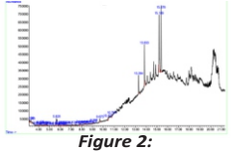

Figure 2:
GC-MS Chromatogram of Anacardium occidentale (stem bark)

Table 6: Qualitative Analysis for Zanthoxylum Zanthoxyloides and Anacardium occidentale.

S/N	Sample	Flavonoids	Alkaloids	Saponins	Phenolic	Tannins	Steroids	terpenoids	Glycoside
1	*Z. zanthoxyloides*	+++	+	+	++	+	+	++	+
2	*A. occidentale*	+	+	+	+	+	+	+	-

CONCLUSION

Contact toxicity observed showed that both powders and oils of *Z. zanthoxyloides and A. occidentale* were effective against *S. oryzae*. Therefore, both plants can serve as alternative control against insects in storage pest management. Further research is required to isolate the bioactive compounds in *Z. zanthoxyloides and A. occidentale* and test individual components for their toxicity.

REFERENCES

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