EVALUATION OF TERMITICIDAL PROPERTIES OF CHEMICALLY MODIFIED CASHEW NUT SHELL LIQUID

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(work in progress)

Outline

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- Results & Discussions
- Conclusion & Recommendation

Abstract

- Cashew nut shell liquid (CNSL), a by-product cashew nut processing contains : anarcardic acid, cardanol, cardol & 2 – methyl cardol.
- Cardanol & cardol were isolated from CNSL using chemical method adopted from Kumar (2002).
- Preservative was prepared by incorporating copper & chlorine in CNSL, decarboxylated CNSL, cardanol & cardol. its efficacy against termites was compared with commercially available termiticide (chlorpyrifos)
- Test samples were coated with preservatives formulated, another batch chlorpyrifos & control being wood blocks dipped in distilled water then introduced at ant hills having a nest of *Microcerotermes beesoni* for 60 days.
- Keen observations were made on feeding habits of termites on wood samples of *Juniperus procera, Grevilea robusta*, & *Pinus insularis*.
- % weight loss was calculated for each block after termite exposure & knife test carried out to determine the extent of destruction.

Introduction

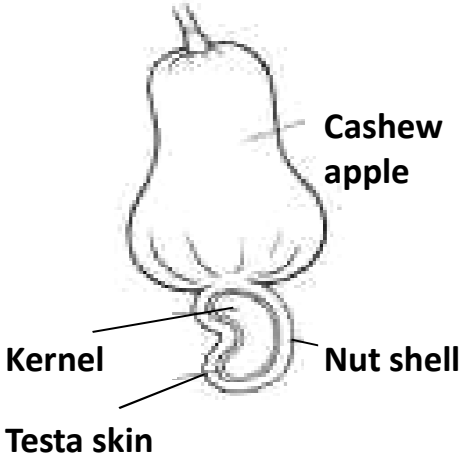
Termites

•Termites are social insects classified in the family ***Termitoidae,*** order ***Blattodea*** and live in colonies.

•Important in recycling of wood and other dead matter hence are of ecological importance.

Cashew Trees

Cashew Apples (yellow and red) and Nuts



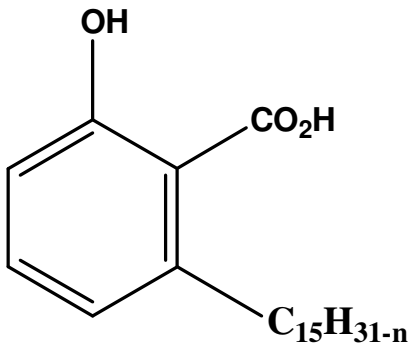
Cross section of Cashew Apple and Nut

Literature Review

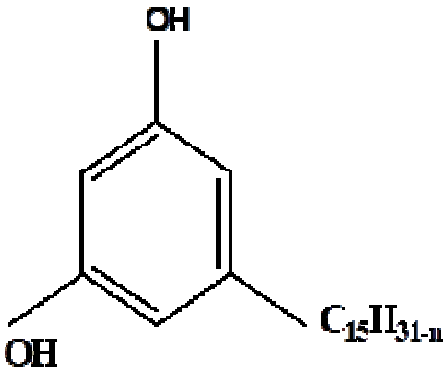
CNSL

- Is a by-product of cashew industry obtained either by extraction in hot oil (or in solvents) or by mechanical expulsion from the shells.
- CNSL appears as a reddish brown viscous liquid in the soft honeycomb structure of the shell of cashew kernel.
- Constituents of CNSL: anacardic acid, cardol, cardanol and 2-methlycardol & they can serve as alternative source of phenolic compounds from petrochemical industry.

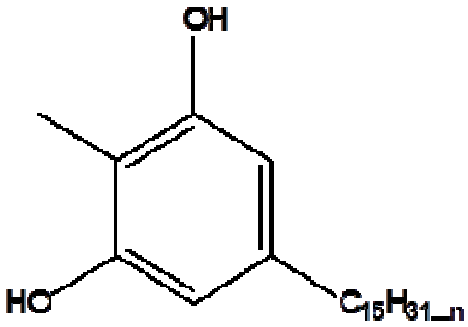
Major fractions of CNSL



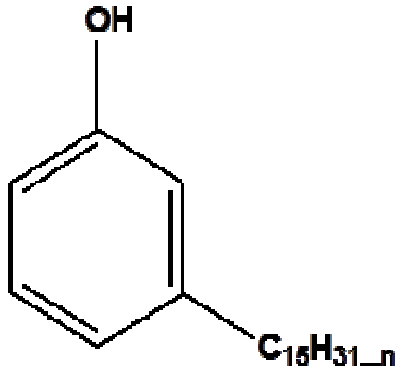
Anacardic acid



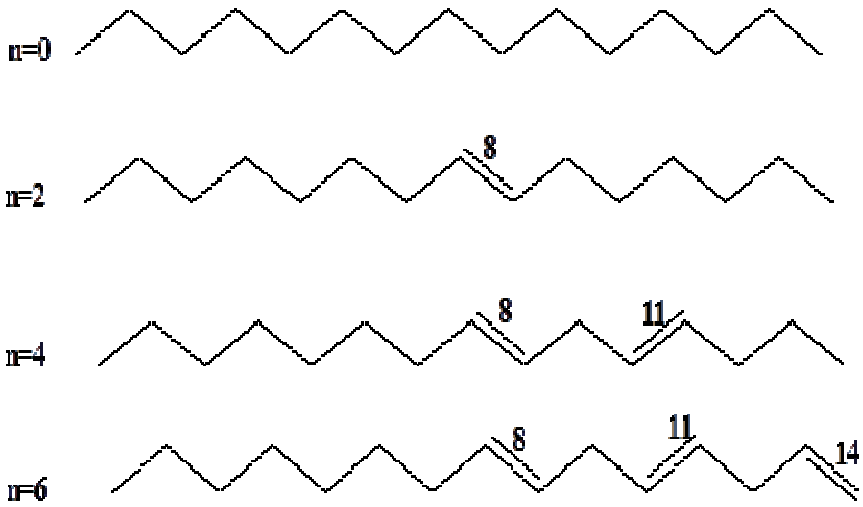
Cardol



Methyl cardol



Cardanol



Wood Preservatives

- Wood products are subject to termite & bio-hazard attacks; if preventive measures are not taken, it results to reduced service of wood products.
- Work has been done to impart durability by treating wood with natural & synthetic chemicals (Purushotham, 1970).
- Conventional preservatives though very effective against wood destroying organisms cause environmental pollution & a few are hazardous to mammals (Onuorah, 2000).

- Efforts have been made world-wide to find safer biodegradable substitutes for synthetic insecticides (Crombie, 1990).
- Among these efforts is the use of CNSL, whose efficacy as seed protectant for cow pea seeds in storage has been reported (Echendu, 1991; Ofuya & Fayape, 1999.).
- CNSL is active as a pest control & has been tested as a bactericide.

Termiticides & Repellents developed from CNSL

- Has been reported to accord protection against termites & has water repellency properties (Lepage and Delelis, 1980).
- Due to its phenolic nature, it has been used as an outstanding preservative for timber and textile against insect and fungus attack (Ohler, 1979).
- Chlorinated CNSL has been reported to have good insecticidal, pesticidal and germicidal properties (John *et al*., 1964).
- Copperised CNSL can be thought of as a good preservative and this observation confirms with that of (John *et al.*, 1964) where he proved the bio-cidal efficacy of CNSL.
- Due to its versatility in chemical nature, it offers a number of possibilities to be modified and it has been found very reactive to copper and zinc (Venmalar and Nagaveni, 2005).

Statement of the Problem

- Termites cause massive damage to structures & end up being costly in the long run.
- Wastes generated from cashew industry in Kenya have brought concern over their health & environmental implications.
- Cashew nut shells are normally burned to provide energy for processing of the nuts.
- Burning produces heavy dark smoke & soot which pollutes the environment profoundly.

Justification

- Wood being ligno-cellulolytic material is liable to degradation & since its supply is limited, it is necessary to protect the wood in service from biological deterioration.
- Currently, CNSL is not commercially exploited in Kenya & the sheer volume of cashew nut shells generated along the production line poses a challenge for waste disposal.
- We could harness this by-product by extracting additional product for industrial use and secondary processing firms could create jobs apart from economic benefits and also offer a better method of disposal than burning the entire shells containing CNSL.

Objectives

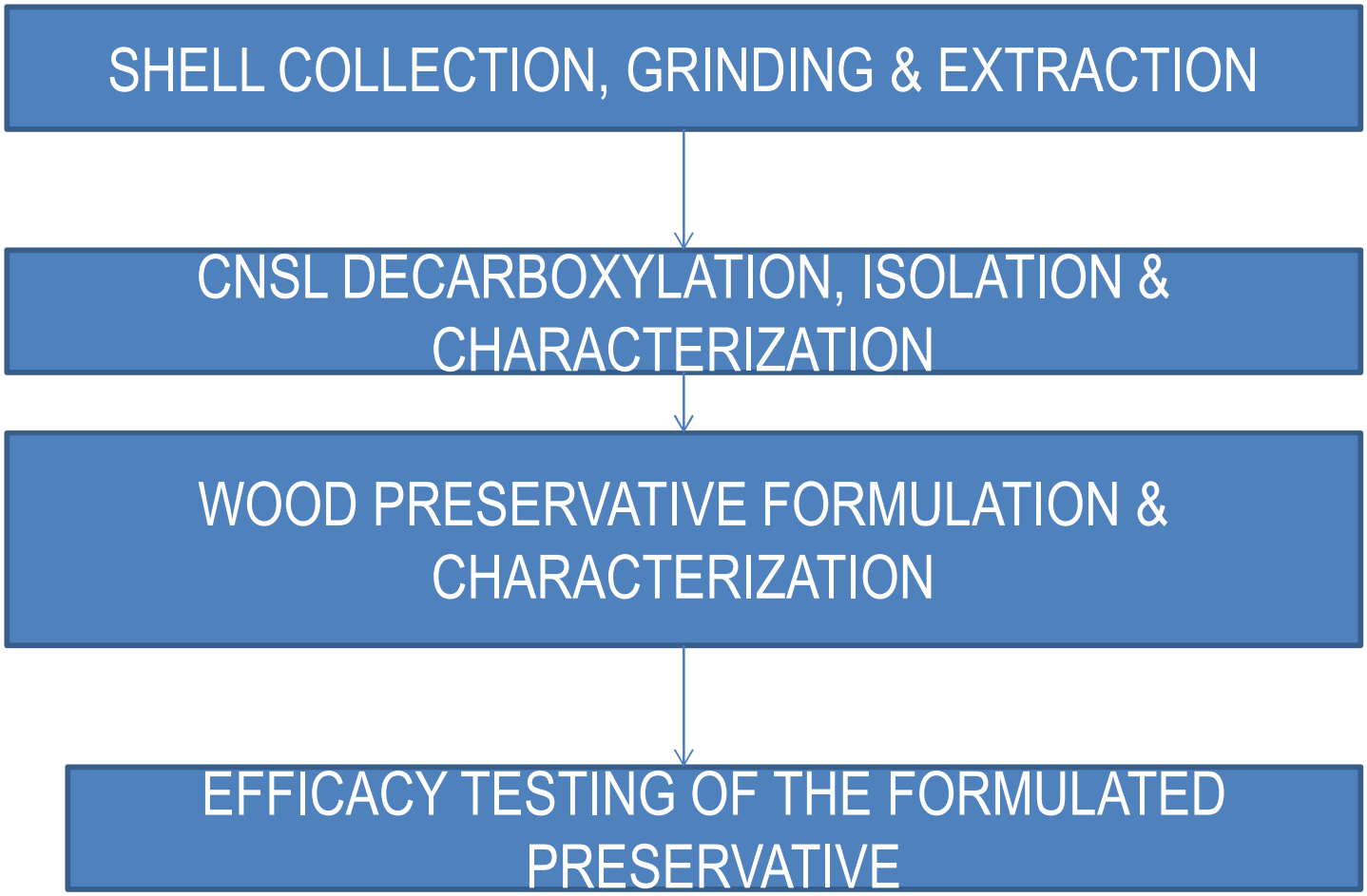
General Objective

To determine the efficacy of chemically modified CNSL as a termiticide or repellent compared to commercially available termiticide (chlorpyrifos)

Specific Objectives

- To extract CNSL from cashew nut shells by batch extraction method: isolate cardanol & cardol from CNSL using chemical method.
- To characterize CNSL, cardanol and cardol obtained.
- To develop termiticide and repellent based on chemically modified CNSL and its derivatives.
- To test the efficacy of the termiticide and repellent developed compared to commercially available termiticide especially Gladiator (chlorpyrifos).

Materials & Methodology



Results & Discussion
Characterization of CNSL & it's Derivatives

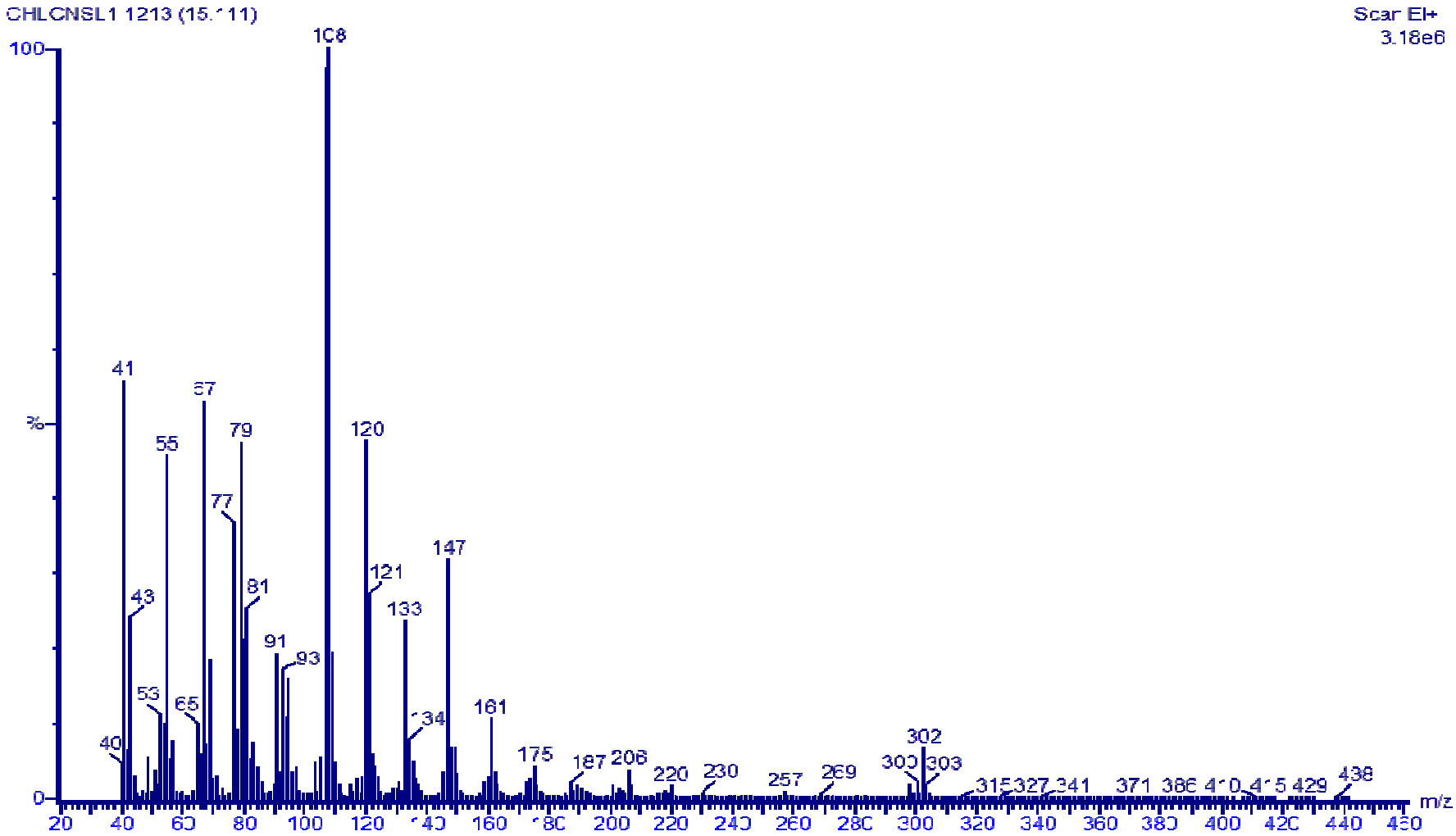
Test	CNSL	Decarb. CNSL	Cardanol	Cardol
pH	3.07	6.02	5.08	4.4
Sp.gravity	0.977	0.963	0.950	0.951
Acid val	12	11.2	10	10.4
Iodine val	243.79	243.07	243.12	243.69
Viscosity	49.56	47.78	45.12	46.53

- Raw CNSL - high relative density - anarcadic acid as the major fraction; there is intermolecular attraction between the electronegative oxygen atom & the partially positive hydrogen atom of the phenol core resulting in the molecules being closely packed together.
- Decrease in specific gravity in decarboxylated CNSL is due to the release of CO_2 gas during the decarboxylation process.

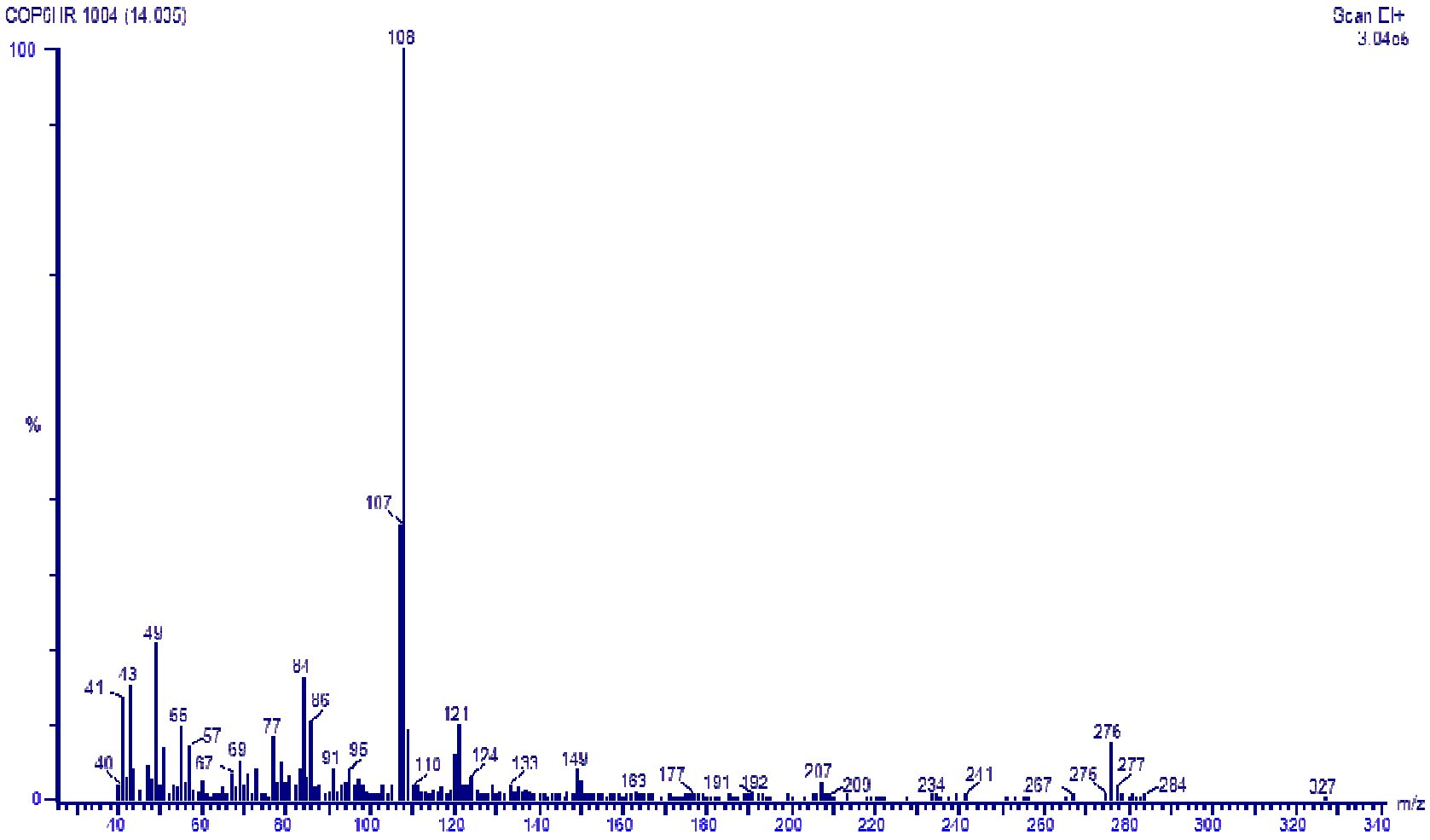
- No significance difference in the iodine values - iodine value is a measure of the amount of unsaturation in a given oil and we are considering the same side chain. The high iodine values of more than 140 in the fractions show that they are drying oils.

- There is a significance difference in the viscosity values. Raw CNSL has anarcardic acid as the major fraction with the –COOH group in the ortho position of the phenol core and therefore there is strong dipole–dipole attraction between the partially positive charged hydrogen atom and the strong electronegative oxygen atom.
- These values were similar to those recorded in literature.

Chlorinated CNSL



Copperised CNSL

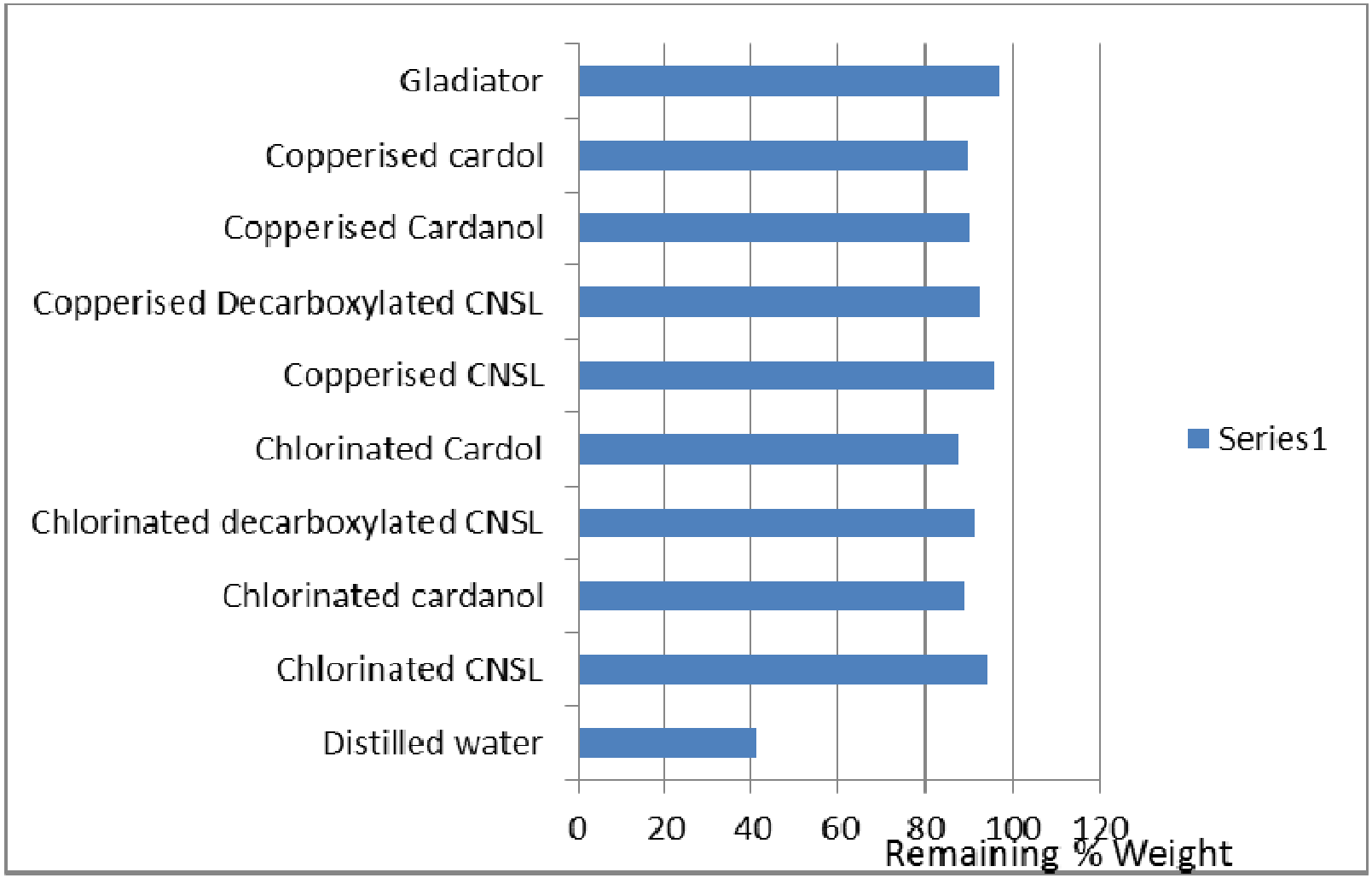


- Chlorinated CNSL has its base peak at m/z = 108 & this is as a result phenolic compound experiencing fragmentation in it beta position of benzyl ring to form tropolium ions.
- Molecular ions (M+ & M+2) signifies the presence of the chlorine isotopes observed at m/z = 300 & 302.
- Copperised CNSL had the same base peak at m/z = 108: indicates the formation of tropolium ions.

% weight loss of wood blocks of *Pinus insularis, Juniperus procera* & *Grevilea robusta* after exposure for 60 days in a nest of *Microcerotermes beesoni*

Preservative	*Pinus insularis*	*Juniperus procera*	*Grevilea robusta*
Control	64.8	60.1	54.2
Gladiator	4.2	2.7	2.1
Chlorinated CNSL	6.4	5.8	5.2
Chlorinated Cardanol	10.9	11.1	11.3
Chlorinated Cardol	12.4	12.2	11.9
Copperised CNSL	4.8	3.9	4.5
Copperised Cardanol	9.9	8.2	10.7
Copperised Cardol	10.4	9.3	9.8

Test of means of wood destruction/preservative threshold standard error of each mean at $P < 0.01 = 0.946$


Gladiator
Copperised cardol
Copperised Cardanol
Copperised Decarboxylated CNSL
Copperised CNSL
Chlorinated Cardol
Chlorinated decarboxylated CNSL
Chlorinated cardanol
Chlorinated CNSL
Distilled water
0
20
40
60
80
100
120
Remaining % Weight
Series1

Termite Screening Responses

- Some of the damage responses showed almost similar results to the commercial termiticide (chlorpyrifos).
- No dead termites were recorded on the test ground surfaces suggested that the blocks were not, or only slightly damaged because the preservative acted as termite repellants or made the blocks unpalatable to termites
- It should be noted however, that there was no consistency in weight losses & this could have been due to uptake of moisture or soil particles from the test grounds.
- A study is underway to identify the cause of this inconsistency.

Conclusions & Recommendations

- Sharp differences between preservative effectiveness on test wood damage have been noticed in terms of the test wood damage response & weight loss.
- Preservatives made the wood blocks unpalatable to termites or are termite repellents.
- The formulated preservatives should be tested against other termite species and if they are active, there is a necessity to try the preservative on a large scale, for it may turn out to replace the environmentally unfriendly wood preservatives currently used in the country.

Thank You