Efficacy of Plant Extracts Against Subterranean Termites i.e., *Microtermes obesi* and *Odontotermes lokanandi* (Blattodea: Termitidae)

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Abstract

Leaf and seed crude extracts at three concentrations (high, medium and low) of Euphorbia heliocapra L., Cannabis sativa L., and Calotropis procera (Ait.) were tested against workers and soldiers (4-5th instar) of Microtermes obesi Holmgren and Odontotermes lokanandi Chatarjee and Thakur (Blattodea: Termitidae). Results revealed that all extracts showed moderate toxic effect. 100% mortalities were found in M. obesi and O. lokanandi on day 11 and 7 respectively. Our results showed that Mortalities in both species were concentration depended. Maximum mortalities were observed in high concentration, followed by medium and low. Our results also indicated that M. obesi was more resistant than O. lokanandi.

Keywords: M. obesi, O. lokanandi, E. Helioscopia, C. Sativa, C. Procera, Concentration; Seed; Leaf

Introduction

Subterranean termites are highly destructive polyphagous insect pests [1], which largely damage house hold materials. They damaged goods, plants and agricultural crops such as sugarcane, millet, barley and paddy [2]. It is estimated that billions of dollars are spent annually to control termites worldwide [3]. In the past, the control of termites has been totally based on chemicals, especially synthetic insecticides of photochemical or crude plant extracts on insects are manifested in particularly promising [8,9]. The plant extracts with complex mixtures protection, agriculture and household pest management have been explored for their anti-feedant and insecticidal activities. Researchers reported that many plants have been recognized to have anti-termitic activities [23,31-35].

Replacement of synthetic insecticides with bio-pesticides is a universal acceptable and practical approach worldwide [7]. Plant extracts offer a vast, virtually untapped reservoir of chemical compounds with many potential uses. One of these uses is in agriculture to manage pests with less risk than with synthetic compounds that are toxicologically and environmentally undesirable. Various experiments using plant extracts in human and animal health protection, agriculture and household pest management have been particularly promising [8,9]. The plant extracts with complex mixtures of such compounds have been investigated for their insecticidal, repellent, and anti-feedant properties [10-13]. The deleterious effects of photochemical or crude plant extracts on insects are manifested in several ways, including suppression of calling behaviour [14], growth retardation [15], toxicity [16], oviposition deterrence [17], feeding inhibition [18] and reduction of fecundity and fertility [19].

Plants contain chemicals such as terpenoids, flavonoids, saponins, etc. or mixtures of chemicals that repel or kill termites or interfere with their gut flora [20-24]. In the past for termite control few plant species such as Pseudotsuga menziesii (Mirb.), Lysitoma seemnii L., Tabebuia guayacan (Seem.), Diospyros sylvestra Roxb. [25], Curcuma aromatica Salisb. and Euphorbia kansuii GanSui. [26], Eucalyptus globules L., lemon grass, Eucalyptus citrodora (Hook.), cedar wood, clove bud and vetiver grass [11], Taiwania cryptomerioides Hay. [27], Dodonaea viscosa (L.) Jacq. (Purple hop bush) a termite resistant shrub [28], Ocimum basilicum L., Cymbopogon winterians Jowitt, Cinnamomum camphora (L.) Nees and Eberm., Rosmarinus officinalis L. [29] and Coleus amboinicus (Lour.) [30] have been used by [36] and these termites were acclimatized in Entomological laboratory of National Agriculture Research Center, Islamabad. These termites were identified by using the taxonomic keys designed by Chaudhry et al.

Materials and Methods

Collection of Experimental Termites

The experimental termites were collected from an infested termites building situated in Rawal Town, Islamabad by trapping technique used by [36] and these termites were acclimatized in Entomological laboratory of National Agriculture Research Center, Islamabad. These termites were identified by using the taxonomic keys designed by Chaudhry et al.

Extracts preparation

Three fresh and healthy plants of Euphorbia heliocapra L. (Sun spurge), Calotropis procera (Ait.) (Ak) and Cannabis sativa L. (Bhang) were collected from Islamabad. These plants were brought in the Entomological Laboratory of National Agriculture Research Center, Islamabad. Aqueous extracts of leaves and seeds of each plant were prepared in three levels i.e., 50, 35 and 25% (high, medium and low) by using the methodology of [37] with some modifications.
Bioassay

Force-feeding tests were conducted following the procedure adopted by [38]. Petri dishes having (dia. 5.5 cm) were used as experimental units. These were sterilized in the oven at 200°C. Circular filter papers were cut and the bottom of each sterilized glass Petri dish was provided with two of them and the lid of each Petri dish with one. Each filter paper in the bottom was soaked with 0.2 mL of the respective extracts concentrations to the extent that it was fully absorbed. Soaking was carried out with the help of a syringe. For each concentration a new syringe was used. Distilled water was used for control. Each treatment was replicated three times. Then populations of 50 termites (45 workers and 05 soldiers) of 4th–5th instar (as determined by size) were added to each Petri dish. The Petri dishes were placed in the desiccators having 92% relative humidity. These desiccators were kept in laboratory at temperature (27 ± 30°C) and relative humidity (60 ± 5%). Daily observations were taken and the dead individuals in each Petri dish were removed through forceps.

Statistical Analysis

The data was converted to percentage by using the following formula:

\[
\text{Percent Mortality} = \frac{\text{Total number of dead termites after treatment} \times 100}{\text{Total number of termites before treatment}}
\]

Then the percent mortality was corrected by using Abbotts formula [39]. The experiment was designed as a completely randomized experiment. Statistical computing was performed by using Co-Stat. Means were separated by using Least Significant Difference (LSD) at P<0.05

Results

**Euphorbia helioscopia**

**Microtermes obesi**

Results (Table 1) showed percent mortalities in *M. obesi* was 100.00 ± 0.00, 91.06 ± 3.16 and 85.82 ± 2.17 at high, medium and low concentrations of leaf extract of *E. helioscopia*, respectively in 11th day. The analysis revealed that the percent mean mortality recorded at medium and low concentrations was found non-significant (P>0.05), but significantly differed from high aqueous concentration; whereas percent mean mortalities in *M. obesi* by using seed extracts at high, medium and low concentrations of *E. helioscopia* were 100.00 ± 0.00, 100.00 ± 0.00 and 94.17 ± 3.06, respectively, which was statistically similar (P>0.05).

**Odontotermes lokanandi**

Results (Table 2) showed percent mean mortality in *O. lokanandi* were 100 ± 0.00, 93.32 ± 3.35 and 78.83 ± 5.29 at high, medium and low concentrations of leaves of *E. helioscopia*, respectively in 7th day. Results indicated that percent mean mortalities were non-significant (>0.05) at high and medium concentrations, but significantly differed (P<0.05) from mean percent mortality at low concentration; while percent mortalities were 100.00 ± 0.00, 76.58 ± 4.12, 75.15 ± 7.08 at high, medium and low concentrations of seeds, respectively in 6th day. Statistically the percent mortality at medium and low concentrations was found non- significant (P>0.05), while significantly different (P<0.05) from percent mean mortality recorded at high concentration (Table 2).

| Table 1: Mean percent mortality in *Microtermes obesi* at leaf and seed extracts of different concentrations of *Euphorbia helioscopia* |   |
|---|---|---|---|---|---|---|
| Leaf | | | | Seed | | |
| After day’s | High | Medium | Low | High | Medium | Low |
| 1 | 3.40 ± 0.68a | 3.40 ± 0.68a | 2.72 ± 0.68a | 2.05 ± 1.18a | 2.07 ± 0.01a | 1.37 ± 0.69a |
| 2 | 6.25 ± 1.20a | 5.56 ± 0.69a | 4.39 ± 0.69b | 5.59 ± 1.37a | 4.89 ± 0.68a | 2.79 ± 0.69a |
| 3 | 18.70 ± 0.67a | 15.09 ± 1.14b | 11.49 ± 1.82c | 11.03 ± 1.29a | 9.55 ± 1.44a | 5.86 ± 1.91b |
| 4 | 27.99 ± 1.64a | 24.22 ± 1.23b | 21.94 ± 1.26c | 19.82 ± 1.89a | 16.01 ± 1.22b | 12.19 ± 1.44c |
| 5 | 38.98 ± 1.96a | 34.93 ± 1.24ab | 32.47 ± 1.69b | 36.00 ± 0.29a | 31.20 ± 1.40b | 25.61 ± 0.92c |
| 6 | 53.42 ± 1.86a | 48.29 ± 1.13ab | 45.77 ± 0.38b | 52.87 ± 1.62a | 36.36 ± 1.42b | 33.88 ± 0.27b |
| 7 | 57.01 ± 1.65a | 53.26 ± 0.92ab | 50.45 ± 0.94b | 64.99 ± 1.27a | 53.04 ± 1.57b | 49.59 ± 1.11c |
| 8 | 66.61 ± 2.05a | 62.62 ± 0.12b | 58.54 ± 1.16c | 79.46 ± 1.74a | 72.90 ± 0.82b | 69.08 ± 2.11b |
| 9 | 74.68 ± 1.32a | 69.21 ± 2.01ab | 64.61 ± 2.54b | 88.91 ± 2.44a | 83.69 ± 0.82b | 79.61 ± 0.55b |
| 10 | 87.83 ± 3.50a | 76.14 ± 1.04b | 72.75 ± 2.09b | 95.70 ± 2.15a | 92.40 ± 2.08b | 86.87 ± 1.67c |
| 11 | 100.00 ± 0.00a | 91.06 ± 3.16b | 85.82 ± 2.17b | 100.00 ± 0.00a | 100.00 ± 0.00a | 94.17 ± 3.06a |

Different letters within a row indicate differences of P<0.05.
Cannabis sativa

Microtermes obesi

Results (Table 3) indicated that percent mean mortalities in M. obesi at high, medium and low aqueous concentrations of leaf extracts of Cannabis sativa were 100.00 ± 0.00, 98.01 ± 0.10 and 95.00 ± 0.98, respectively in 11th day. Statistically the percent mean mortality at high concentration was found non-significant (P<0.05) from percent mean mortality at medium, but significantly higher (P<0.05) from observation recorded at low concentration; while 100% mortality was recorded at high concentration of seed extracts of Cannabis sativa in 11th day, which is statistically non-significantly different (P>0.05) from percent mean mortality recorded at medium concentration and significantly higher (P<0.05) from percent mean mortality recorded at low concentration.

Odontotermes lokanandi

Maximum (100 ± 0.00) percent mean mortalities in O. lokanandi were recorded at high concentration of leaf extract of Cannabis sativa in 7th day, which was found similar (P>0.05) to percent mean mortalities (94.21 ± 3.22) recorded at medium concentration and significantly different (P<0.05) from percent mean mortality (81.58 ± 2.30) noted at lower concentration (Table 4); whereas percent mean mortalities in O. lokanandi were 100.00 ± 0.00, 93.31 ± 3.35 and 80.13 ± 2.32 at high, medium and low concentrations of seed extracts of

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**Table 2:** Mean percent mortality in Odontotermes lokanandi at leaf and seed extracts of different concentrations of Euphorbia helioscopia. Different letters within a row indicate differences of P<0.05.

| Leaf | Seed |
|------|------|
| After day's | High | Medium | Low | High | Medium | Low |
| 1 | 8.97 ± 0.72a | 8.97 ± 0.72a | 6.55 ± 0.30a | 8.99 ± 2.46a | 6.19 ± 2.33ab | 2.75 ± 1.37b |
| 2 | 15.67 ± 0.11a | 16.41 ± 0.69a | 11.94 ± 0.70b | 24.96 ± 2.45a | 13.89 ± 2.43b | 8.61 ± 1.25c |
| 3 | 19.99 ± 1.31a | 16.67 ± 0.87ab | 12.48 ± 1.38b | 37.46 ± 2.43a | 41.96 ± 2.87b | 37.66 ± 2.62b |
| 4 | 34.55 ± 0.82a | 31.82 ± 0.81a | 25.63 ± 1.34b | 60.40 ± 2.43a | 52.42 ± 1.64b | 51.13 ± 4.34b |
| 5 | 54.52 ± 1.55a | 48.54 ± 0.85ab | 40.48 ± 2.62b | 76.58 ± 4.50a | 75.15 ± 7.08b |
| 6 | 80.07 ± 3.04a | 68.80 ± 2.92b | 61.22 ± 0.89ab | 100.00 ± 0.00a | 100 ± 0.00a |

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**Table 3:** Mean percent mortality in Microtermes obesi at leaf and seed extracts of different concentrations of Cannabis sativa. Different letters within a row indicate differences of P<0.05.

| Leaf | Seed |
|------|------|
| After day's | High | Medium | Low | High | Medium | Low |
| 1 | 4.75 ± 0.62a | 4.74 ± 1.32a | 3.39 ± 0.65a | 8.05 ± 0.05a | 7.37 ± 0.63a | 7.36 ± 1.74a |
| 2 | 9.07 ± 0.56a | 6.95 ± 1.74ab | 6.27 ± 1.13b | 12.33 ± 0.09a | 10.94 ± 1.30a | 9.58 ± 1.33a |
| 3 | 19.26 ± 1.00a | 17.12 ± 1.02ab | 15.67 ± 1.66b | 21.50 ± 1.19a | 19.41 ± 1.60ab | 18.03 ± 1.19b |
| 4 | 27.21 ± 2.27a | 24.22 ± 1.23ab | 21.18 ± 1.30b | 25.07 ± 3.65a | 25.15 ± 0.98a | 22.23 ± 2.25a |
| 5 | 40.69 ± 2.49a | 38.42 ± 1.50ab | 35.32 ± 2.28b | 38.04 ± 2.04a | 34.35 ± 2.15a | 29.05 ± 2.21a |
| 6 | 49.19 ± 1.75a | 46.03 ± 0.39ab | 40.42 ± 2.19b | 47.66 ± 2.31a | 43.04 ± 2.35ab | 38.38 ± 2.53b |
| 7 | 64.17 ± 2.10a | 62.61 ± 0.44a | 56.04 ± 2.03b | 58.63 ± 2.00a | 52.91 ± 0.47b | 49.59 ± 1.11b |
| 8 | 78.23 ± 2.44a | 74.76 ± 1.07a | 69.55 ± 1.12b | 67.31 ± 0.81a | 60.97 ± 1.55b | 56.19 ± 2.06b |
| 9 | 90.18 ± 0.85a | 85.73 ± 0.76b | 80.38 ± 1.71c | 85.97 ± 1.16a | 77.02 ± 0.55b | 72.92 ± 3.29b |
| 10 | 97.17 ± 17a | 89.63 ± 0.90b | 87.75 ± 0.82b | 94.76 ± 1.00a | 89.48 ± 1.00b | 85.28 ± 2.02c |
| 11 | 100.00 ± 0.00a | 98.01 ± 0.10ab | 95.00 ± 0.98b | 100.00 ± 0.00a | 96.70 ± 1.92ab | 91.18 ± 2.89b |
Cannabis sativa in 7th day, respectively. The result indicated that the percent mean mortality recorded at high and medium concentrations were found non-significant (P>0.05), but significantly different (P<0.05) from percent mean mortality noted at low concentration.

| Leaf | After day's | High | Medium | Low | Seed | High | Medium | Low |
|------|-------------|------|--------|-----|------|------|--------|-----|
| 1    | 9.15 ± 1.38a | 7.03 ± 1.39a | 2.80 ± 0.68b | 7.85 ± 1.40a | 6.43 ± 0.05a | 2.13 ± 1.23b |
| 2    | 17.04 ± 0.58a | 12.40 ± 0.79b | 10.04 ± 1.45b | 21.18 ± 1.30a | 19.69 ± 0.56a | 15.17 ± 0.93b |
| 3    | 28.70 ± 2.73a | 21.15 ± 1.40b | 16.87 ± 1.91b | 29.47 ± 2.59a | 25.12 ± 3.13b | 16.41 ± 2.84c |
| 4    | 41.55 ± 0.67a | 32.54 ± 2.60b | 26.59 ± 2.76c | 43.61 ± 2.68a | 38.73 ± 2.82b | 30.94 ± 3.72c |
| 5    | 57.87 ± 2.10a | 47.86 ± 3.93b | 39.29 ± 2.79c | 65.00 ± 3.83a | 57.64 ± 0.72a | 45.54 ± 2.13b |
| 6    | 80.73 ± 2.69a | 65.16 ± 3.31b | 46.48 ± 3.59c | 83.47 ± 3.00a | 76.17 ± 2.41b | 66.72 ± 1.86c |
| 7    | 100 ± 0.00a  | 94.21 ± 3.22a | 81.58 ± 2.30b | 100.00 ± 0.00a | 93.31 ± 3.35a | 80.13 ± 2.32b |

Table 4: Mean percent mortality in Odontotermes lokanandi at leaf and seed extracts of different concentrations of Cannabis sativa. Different letters within a row indicate differences of P<0.05.

Calotropis procera

Microtermes obesi

Results (Table 5) showed that percent mean mortalities in M. obesi were 100.00 ± 0.00, 100.00 ± 0.00 and 95.80 ± 1.03 at high, medium and low concentrations of leaf aqueous extracts of Calotropis procera in day 11 of the trial. The analysis revealed that percent mean mortality at high and medium concentrations was found non-significant (P>0.05), but significantly differed (P<0.05) from percent mean mortality found at low concentration (Table 5); while using seed aqueous, percent mean mortality in M. obesi was 100.00 ± 0.00, 96.04 ± 1.05 and 94.14 ± 1.63 at high, medium and low concentrations in 10th day, respectively. Percent mean mortality recorded at high concentration was found similar (P>0.05) to medium concentration and significantly different (P<0.05) from percent mortality noted at low concentration.
The effects of leaf aqueous extracts of *Calotropis procera* when offered to workers and soldiers of *Odontotermes lokanandi* for seven days in the form of soaked filter paper, percent mean mortality was 100.00 ± 0.00, 93.71 ± 1.83 and 87.43 ± 2.03 at high, medium and low concentrations respectively. The analysis showed that the percent mean mortality recorded at high concentration was found significantly different (P<0.05) from percent mean mortality noted at medium and low concentrations; while by force fed them on aqueous seed extracts of *Calotropis procera*, percent mean mortality was 100.00 ± 0.00, 100.00 ± 0.00 and 91.16 ± 1.15 at high, medium and low concentrations respectively. Results revealed that mortality recorded at high and medium concentrations was found similar, but significantly high (P<0.05) from mortalities found in low concentration.

### Table 6: Mean percent mortality in *Odontotermes lokanandi* at leaf and seed extracts of different concentrations of *Calotropis procera*. Different letters within a row indicate differences of P<0.05.

| Leaf  |   |   |   | Seed  |   |   |   |
|-------|---|---|---|-------|---|---|---|
|       | High | Medium | Low |       | High | Medium | Low |
| After day’s |   |   |   |       |   |   |   |
| 1     | 8.26 ± 1.14a | 4.12 ± 1.77b | 3.43 ± 1.35b | 10.88 ± 0.68a | 9.52 ± 0.68a | 5.44 ± 0.68b |
| 2     | 20.71 ± 1.35a | 17.85 ± 0.66a | 16.42 ± 1.37a | 22.31 ± 0.81a | 19.41 ± 1.12a | 10.05 ± 1.85b |
| 3     | 29.85 ± 1.93a | 28.35 ± 1.39a | 24.63 ± 0.19a | 32.04 ± 0.93a | 28.11 ± 1.17a | 17.16 ± 1.44b |
| 4     | 50.00 ± 1.19a | 45.20 ± 1.84b | 40.47 ± 1.19c | 46.11 ± 2.03a | 43.57 ± 0.83a | 4.97 ± 2.57b |
| 5     | 66.37 ± 2.35a | 61.95 ± 1.57a | 55.79 ± 0.97b | 68.89 ± 2.71a | 62.11 ± 1.81b | 52.35 ± 2.54c |
| 6     | 87.70 ± 1.98a | 82.06 ± 1.04b | 74.52 ± 1.87c | 91.90 ± 4.23a | 80.97 ± 3.37b | 68.65 ± 3.25c |
| 7     | 100.00 ± 0.00a | 93.71 ± 1.83b | 87.43 ± 2.03c | 100.00 ± 0.00a | 100.00 ± 0.00a | 91.16 ± 1.15b |

**Discussion**

Different concentrations of leaf and seed extracts of *Euphorbia helioscopia* were tested against *Microtermes obesi* and *O. lokanandi* for eleven and seven days, respectively. Our results showed that percent mean mortality of both species were directly proportion to the concentrations of treatments. Maximum mortalities in both species were observed at higher concentration. Toxicity ranged in *M. obesi* 2.72 ± 0.68 to 100 ± 0.00 and 1.37 ± 0.69 to 100 ± 0.00 by using aqueous leaf and seed extracts of *E. helioscopia*, respectively; while toxicity ranged in *O. lokanandi* by using leaf and seed extracts of *E. helioscopia* 6.55 ± 0.30 to 100 ± 0.00 and 2.75 ± 1.37 to 100 ± 0.00, respectively. Our results showed that *O. lokanandi* was more sensitive than *M. obesi*. Essential oils and plant extracts are still an important natural resource of pesticides/ insecticides [40,41] or larvicides [42-44] or insect repellents [45-47]. The neem insecticide formulation and Margosan-O are observed toxic against the *C. formosanus* [48,49]. Park and Shin [23] report that garlic oil cause 100% mortality of Japanese termite, *Reticulitermes sp.* Kolbe after 24 h of treatment. Verena and Hertel [50] also indicate that some plant extracts are used for termites control. Several higher plants have been tested to be effective against insect pests and diseases of various crops in the field as well as in store [51]. Our study indicated that extracts of the selected tropical herbal plants possess some insecticidal properties against *M. obesi*, but several variations occurred, based on the concentration of the extracts as these influenced the efficacy or biocidal activities of the plant materials. *Euphorbia helioscopia* is common weed almost every where in Islamabad. Being very chief source further studies are needed for the isolation of the factor (alkaloids) in the said plant.

Toxicity in *M. obesi* ranged from 3.39 ± 0.65 to 100.00 ± 0.00 and 7.36 ± 1.74 to 100.00 ± 0.00 by using leaf and seed extracts of *Cannabis sativa* respectively; while 2.80 ± 0.68 to 100.00 ± 0.00 and 2.13 ± 1.23 to 100.00 ± 0.00 when *O. lokanandi* were force fed on leaf and seed extracts of *C. sativa*, respectively. The results showed that aqueous extract of *C. sativa* contains insecticidal activities and percent mean mortality of both species were directly proportion to the concentrations of treatments. Our results also showed that seed extracts were more toxic that leaf extract of *C. sativa*. McPartlandC [52] indicates that *C. sativa* L. is used as a pest repellent. Seed extracts of *Polygonum hydropiper* L. and *Cannabis sativa* L. against *Heterotermes indicola* and *Coptotermes heimi* are effective more than leaf extracts in both species [53]. Thomas et al. [54] studies that *Cannabis sativa* cause 100% mosquito larvae mortality. Parihar and Singh [55] report that the aqueous extracts of Cannabris sativa are most effective against larval mortality of *Heliotris armigera*. Hiremath and Ahn [56] conclude that *Cannabis sativa* is effective against pest of rice, the paddy brown plant hopper (*Nilaparvata lugens*). The efficacy of *Capparis deciduas* and its combinatorial mixtures against Indian white formication by the workers [57]. Jalees et al. [58] determine the insecticidal properties of Cannabis sativa against the larvae of *Anophles stephensi*, *Culex quinquefasciatus* and *Aedes aegypti* in the laboratory.

Similarly, percent mean mortalities by using aqueous leaf and seed extracts of *Calotropis procera* ranged 2.73 ± 0.67 to 100.00 ± 0.00 and 3.42 ± 0.67 to 100.00 ± 0.00 in *M. obesi* respectively. However, percent mean mortality in *O. lokanandi* by forced feeding on leaf and seed extracts of *Calotropis procera* ranged 3.43 ± 1.35 to 100.00 ± 0.00 and 5.44 ± 0.68 to 100.00 ± 0.00 respectively. Results showed that the insecticidal activities of leaf extracts of *Calotropis procera* were...
significantly lower when compared with insecticidal potency of seed extracts. The results also indicated that O. lokanandi was more sensitive than M. obesi. Mortalities in both species were observed directly proportion to concentrations of plant extracts. Our work tallied with the findings of Ahmed et al. [59] who reports that the crude extracts of Calotropis procera (Ait.) and Datura alba Nees are effective against the termites. Crude extracts of various reproductive and vegetative parts of Calotropis procera (Ait.) has toxic effects on H. indicola [53]. Datura alba Nees, D. stramonium L. and Calotropis procera (Ait.) are the most effective against the termites [60,61]. Subterranean termites are successfully controlled by using leaves extracts of Calotropis procera [62,63], Diospyros sylvestra Roxb [25], Polygonon hydropiper (L) and Pogostemon paviflorus (Benth) [64] Aleuris foordi Hensli (Tung tree) extracts [65] garlic Allium sativum L. and Euphorbia kansuii GanSui [26]. Manzoor et al. [66] report that activity of crude plant extracts against termites is often attributed to complex mixture of active compounds and that Ethyl acetate extract of Ocimum sanctum L.

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