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Feeding preference of pestiferous *Microtermes obesi* (*Blattodea: termitidae*) on different timbers under natural condition

Abstract

Microtermes obesi is a termite species extensively present throughout Pakistan and causes detrimental effects on standing trees, crops and timbers. In this study, the feeding preferences of *M. obesi* for 16 different wood species were determined through choice trials under natural field conditions. In choice field trials, different combinations of wooden blocks were used to determine wood consumption by *M. obesi*. Wood weight loss, its consumption and rate of survival of different wooden species were calculated. *Cordiamyxa* was found to be the most susceptible wood species and *Cassia fistula* the most resistant one. Sixteen different wood combinations were used under choice field conditions; maximum feeding was recorded in *Cordiamyxa and Moringa oleifera* (39.15-33.00g). Though, minimum feeding was noted in *C. fistula* (1.41 g) and *Heterophragma adenophyllum* (24.38 g). Under choice natural field conditions, minimum feeding was recorded in *C. fistula* (1.41g) and maximum feeding in *Cordiamyxa* (39.15g). Feeding preferences in descending order based on wood consumption as a quantitative parameter documented were as follows: *Cordiamyxa > Moringa oleifera >Bombax ceiba > Bambusa bamboo > Syzygium cumini > Albizia lebbeck > Dalbergia sissoo > Psidium guava > Pinus roxburghii > Acacia nilotica > Bauhinia variegata >Azadirachta indica > Eucalyptus camaldulensis > Mangifera indica > Heterophragma adenophyllum > Cassia fistula*. This research communicates the basis of a developing a bait strategy for the efficient control of pest termite.

Keywords: feeding preferences, *Microtermes obesi*, choice field trials

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Introduction

Termites being social insects with division of labour as follows: soldiers, reproductive adults and workers.[1] Termite forms both subterranean and above ground network of colonies for living. Cellulose material in wood is eaten by subterranean termites thus impart a serious damage to buildings and agricultural plants.[2] They are present especially in the tropical and sub-tropical regions of the globe. Symbiotic association of termite gut microbes are important in digesting wood.[3] Termites play a tremendous role in recycling and decaying of materials but are serious threat to agricultural crops and buildings. Many plant extracts have been found having anti-termite properties.[4] Ecologically termites are significant through a negative and positive role similar to breaking down wood debris which greatly benefits forest's environment and therefore assume them as a pest.[5] Termite's biodiversity at Bahawalnagar of six species, "*Coptotermes heimi, Odontotermes obesus, M. mycophagus, Odontotermes guptai, Microtermes obesi & Amitermes* sp." in earth, were noted at 250 soil core measuring of depth 30x30 centimeter. Following 4 species of termites, *"M. mycophagus, M. obesi, M. unicolor and E. paradoxalis*," was recorded by Akhtar and Shahid.[6] in cotton fields from Multan area. They informed the high density of termite's population in the fields of cotton (148.2 m-2) was noted during October. Four termite's species namely, "*M. obesi, M. mycophagus, E. paradoxalis, and O. guptai,*" foraging in the crops of wheat was reported by Akhtar and Sarwar.[7] from Bahawalpur division. During wheat-growing season they reported the population density of termites was different from 113.25 to 3437.0 m2. Current study shows that termites population density ranges from 2.40 to 124.44 m2 which also involves soil cores from district Bahawal Nagar. In developed countries like America and Asia the economic role of termites is important in commercial entomology, causing many millions pounds of cost destruction in buildings. The damage caused by natural disasters, fires etc. in single year in some countries is of less cost than the damage caused by termites to houses. The termites destroying huts and the crops of local poor existing farmers of developing countries having even worse impact. Many villages in Egypt and India have been destroyed by termites and the residents were enforced to migrate to new localities. Antique temples are to be pounced by termites in Asia[8]. An important role is played by animal interactions to understand the environmental procedures. These interactions can form the effects of organisms to their environment according to their concentration and nature. Due to high biomass of ants and termites and the limit of environmental roles they have significant effects on the environment, this interaction among them is significant for the practices of the ecosystem. Bahawalnagar district is located from 28°-51' to 30°-22 & 39; North latitude and from 72°-17& 39; to 73°-58 & 39; East longitude. The climate of Bahawalnagar in summer is very hot and dry and during winter it is cold and dry. The beginning of the summer season is from April and it lasts up to October. During May, June and July the weather is very hot, while in December, January and February the weather is too cold. From different ecological regions of Pakistan fifty species of termites have been recorded by Akhtar.[9] However due to the scarcity of data concerning to their large quantity and foraging activities in various climatic zones of Pakistan. On the Basis of these information's, population's density of termites and its variety in the desert range of district Bahawalnagar were studied to compare it with the other environmental regions of Pakistan. The polymorphic morphological forms of termite with eusocial insects belong to infraorder Isoptera.

The wood consumption factors affecting on termites are numerous and highly inter related. In termite wood consumption the influential parameters in palatability are wood species. The preferences of woods feeding and their resistance will differ according to the hardness of wood, and its lignin contents or chemical composition.

The occurrence of carbon-based compounds such as Phenol, aromatic ketones (Quinones), terpenoids, and high contents of lignin can also affect the feeding of the wooden species. Wood contents pH is also important in the termite's feeding. High concentration of starch and sugar in sapwood make it more preferred for feeding for termites than heart wood. Many of the native trees have developed chemical defenses therefore are more resistant to termite attack and to protect themselves protect themselves under natural condition. Immature trees and crops have strong chemical defenses, which make them less vulnerable to termites. In these trees chemical concentrations can vary from outer to inner regions of the wood. Due to cracks in bark in older trees, the resistant chemicals do not exist in or nearer to the surface layers of trees which potentially permitting to occur termites attack. Feeding preferences of termite can be replaced by substitution of an altered wooden species. The choice feeding trial was a very suitable technique to be used in the determination of termite's wood preference than the forced-feeding (no choice test) because in the later assessment technique, termites were enforced to feed on any kind of food resource which is offered for survival. The common termite species of Pakistan which cause loss to timbers and wooden structures are, *"Odontotermes obesus, Coptotermes heimi, Microtermes obesi* and *Heterotermes indicola"*. These termite species inside the houses of Pakistan have become main structural pests of timbers and timber constructions in Lahore and becomes the most damaging termite species. The importance of timbers which have termite's resistance (durable) in Pakistan is eco-friendly. It is a cheap source to protect structural timbers from the attack of termites and destruction. The presence of termite resistant components of wood prevents it from termite attack which are unequally distributed to the all plant parts. The presence of carbon based chemicals like phenols, quinone, terpenoid and higher amount of lignin affects the feeding area in plants. These components are present in greater quantity in heartwood and sapwood and lower in tip of stem. The occasional presence of vital oils in plants prevents it from the attack of termites. In the research it was observed that the sufaida (*Eucalyptus*) vital oil is a active toxic agent and cause gastrointestinal toxicity in termites Rasib et al.[10] 20. Natural resistance against termites is present in the tropical forests plants species and it might provide an alternative usage of the chemical products. Hardness of wood, occurrence of toxic materials, inhibitors of feeding or deterrent, occurrence or fungal absence, level of mycological decay, contents of moistness in woods and in soil are considered as the most important factors of timber species. The objective of current research work was to check feeding preference on various timber species contrary to *Microtermes obesi* an underground termite species under natural field conditions. Experts of termites have concluded that many wooden species seem to have much resistance to termite's attack than other wooden species. The study showed that the contents of moisture, chemical nature of the wood extracts, hardness of timber, variations among heartwood and sapwood are among the major factors considered by termites for wood selection. Termites also consider the type and amount of pre-existing fungus attack for selection of timber. The red wood extract has lethal effect on protozoan present in gut of termite thus causing high mortality in red wood. Wolcott found that the wood having high contents of resin and lignin are termite resistant. Michaud et al.[11] reported association among termite's resistance of wood and amount of lignin, ashes, and proteins contents of many types of timbers. Keeping in view the damage due to termites on environment and important woods, the current study was designed to compare preferences of feeding of *Microtermes obesi* on sixteen different timber species under natural condition. The main objective of this study was to explore the termiticidal potential of termiticidal wood.

Materials & methods

Termite Sampling

Samples of termite collected from Minchin Abad, Bahawal Nagar, Pakistan as shown in Figure 1. Maximum termites were collected from dead infested logs. These termites were moved in the petri dishes along with some dead wooden fragments and were carried.

Figure 1 Site for collection of termites.

Identification of termite

Third instar of workers and soldiers were collected through variable techniques e.g. wetted toilet roll, bucket traps and card boar4d paper roll in plastic bottles having small pores at their base and also having holes on lateral sides for the entry of termite into the bait. The traps were brought to the laboratory, all termites along with moist filter paper kept in a container. The baits were installed in the soil and regularly visited quarter monthly basis. The termites were identified on the basis of the soldier caste using a taxonomic keys of Ahmad and Akhter.[12,13]

Figure 2 *Microtermes obesi.*

Woods selection

Economically important species of wood were selected from different regions of tehsil Minchin Abad and Bahawal Nagar. The diverse tree species which are economically important present above said localities, but among these only sixteen were selected for choice bioassay under field conditions. The wood species were consists of the following wooden blocks as, *Mangifera indica (Mango), Psidium guava(Guava),Cassia fistula (Amaltas),Azadirachta indica (Neem), Eucalyptus camaldulensis (Safaida), Dalbergia sissoo (Shesham), Syzygium cumini (Jaman), Heterophragma adenophyllum (Beri Patta), Albizia lebbeck (Shreen), Bauhinia variegata (Kachnar), Bambusa bamboo (Bamboo), Acacia nilotica (Kikar), Pinus roxburghii (Chir Pine), Bombax ceiba (Sumbal) , Cordiamyxa (Lasura), Moringa oleifera (Sohanjana).*

Field feeding bioassays

Choice bioassay (under field conditions): Blocks of wooden species were desiccated at 60°C for 48 hours. Each wooden block was replicated thrice (n=3). Every block was bounded and arranged together by using copper wire. These blocks then buried 30 cm deep in the soil in vertical and horizontal position, in different localities in tehsil Minchin Abad and Bahawal Nagar. These paired blocks of woods were removed from trial site after three months to observe the consumption of wooden blocks by the help of following formula: WC= W1-W2. As the properties of absorption varies for different species of woods which effect on termite's feeding preferences. This experiment lasted for 3 months under natural conditions at Minchin Abad, Bahawal Nagar as shown in Figure 3-8. Wooden blocks were dismantled after experimentation and hence subjected to post weight assessment active

Figure 3 Site for Trial.

Figure 4 Site for Trial.

Figure 5 Nest of *Microtermes obesi* after digging for choice field trial.

Figure 6 Wooden blocks at trial site.

Figure 7 Infested different wooden blocks. *Microtermes obesi.*

Figure 8 Infested different wooden blocks with *Microtermes Obesi.*

Choice field trials: All the replicates (n = 3) of wood were used for every pair of wooden species. So that a sum total of 48 wooden blocks were prepared and put into the nest of Microtermes obesi, with newly formed humid passageways on the nest surface. Likewise, the termite's nests were excavated and the fungal examines were explored and checked for activeness of the nest. All the wooden blocks were treated with molasses before inserting into the nests. The wood used as bait for termites observed more competitive than other resources of termite's food. Three months later, all the paired wooden blocks were removed from the nests in order to evaluate the consumption rate of wood by the formula given below

WC = W1- W2 Whereas, W1 was considered as pre-weight of wood, while W2, was the post-weight of infested wood. Different species of woods have different absorption properties, which have different effect on preferences of termites feeding. The food resources with high contents of moisture are preferred by subterranean termites. All wooden blocks were removed from the field after three months, dried at 60 C^0 about 72 hours and were reweighed them to estimate the%age of wood quantity loss of the wooden chunks due to *Microtermes obesi* by the given method:

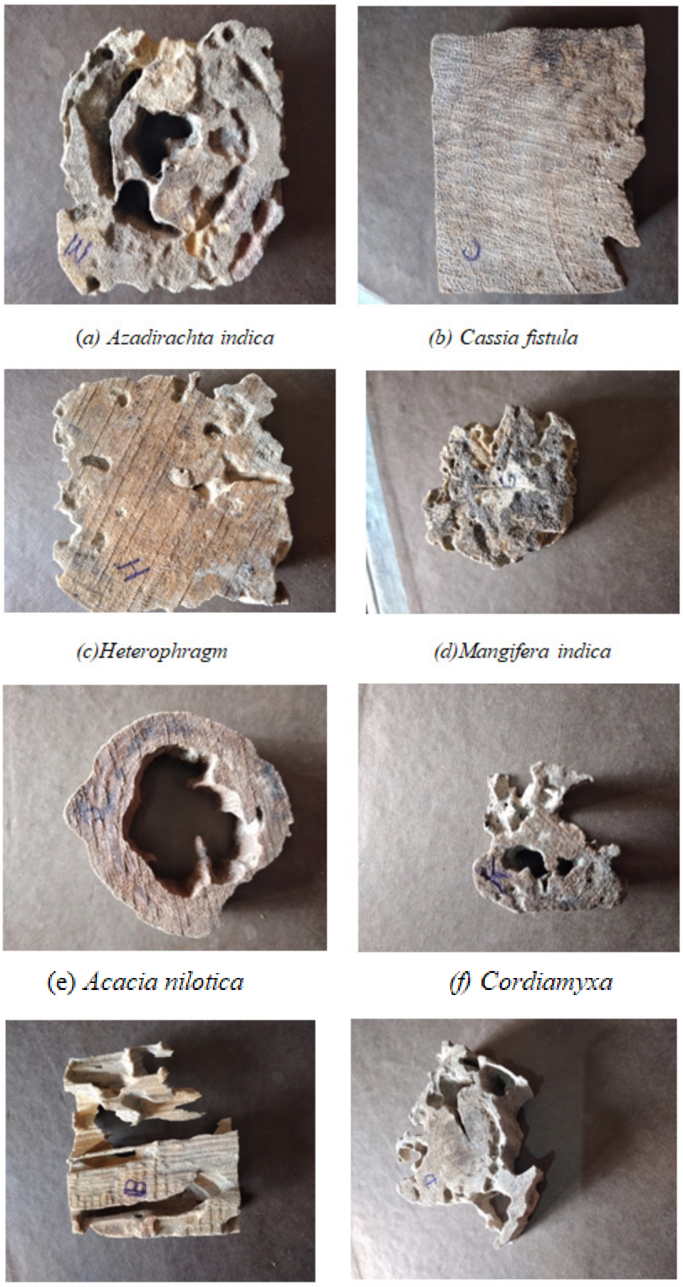
$$WL = (W1-W2) \div (W1) \times 100$$

Statistical analysis: After the trials conclusion, the data of consumption of wood,% age of wood consumption and%age of woods survival were subjected to one-way ANOVA using Minitab (Version-3.8) and Paired comparison t-test were used for field bioassays. Correspondingly, the percentage of mass loss of wooden species and their means in the choice field bioassays was analyzed by Tukey's test.

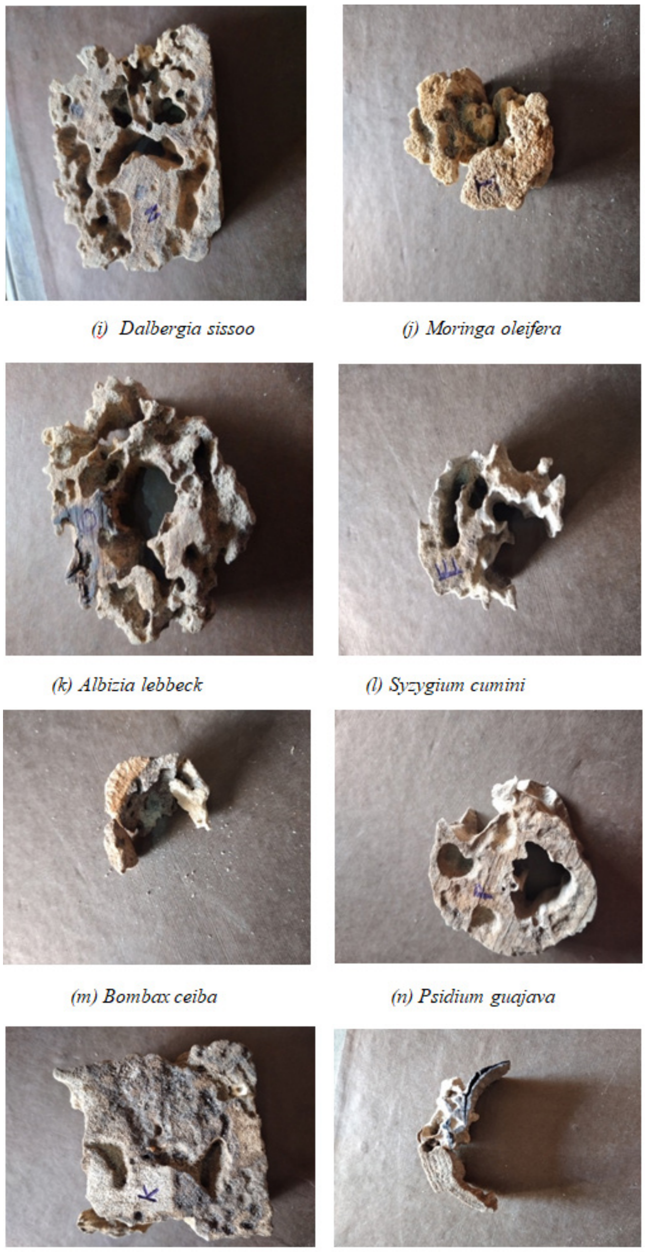
Results

Wooden baits of sixteen different timber species offered to *Microtermes obesi* shows variation in feeding behavior under field conditions. The wooden blocks after *M. obesi* infestation are as in figure 9.

Different eight wooden pairs of various timber species when offered to *Microtermes obesi* shows variation in feeding behavior as in figure 10.



(a) *Azadirachta indica* (b) *Cassia fistula*
(c)*Heterophragm* (d)*Mangifera indica*
(e) *Acacia nilotica* (f) *Cordiamyxa*
(g) *Cordiamyxa* (h) *Eucalyptus camaldulensis*



(i) *Dalbergia sissoo* (j) *Moringa oleifera*
(k) *Albizia lebbeck* (l) *Syzygium cumini*
(m) *Bombax ceiba* (n) *Psidium guajava*
(o) Bauhinia variegata (p) Bambusa bamboo

Figure 9 The damage range caused by *Microtermes obesi* (*Blattodea Termitidae*) workers on 16 different wood species blocks during choice natural field conditions bioassay after 3 months woods used in field experiment are as follows: *(a) Azadirachta indica (b) Cassia fistula (c) Heterophragma adenophyllum (d) Mangifera indica (e) Acacia nilotica (f) Cordiamyxa (g) Eucalyptus camaldulensis (h) Eucalyptus camaldulensis (i) Dalbergia sissoo (j) Moringa oleifera (k) Albizia lebbeck (l) Syzygium cumini (m) Bombax ceiba (n) Psidium guajava (o) Bauhinia variegata & (p) Bambusa bamboo.*

The preference of feeding for sixteen different wooden species by *Microtermes obesi* under choice natural field conditions. These choice feeding trials showed that among the 16 different wooden species *Cordiamyxa* was the most palatable wood species (39.15g) by *M.obesi*. The M. obesi consumed wood of *Cordiamyxa* about 93.01%. While, minimum amount of consumption of wood (1.41g) was practiced in Cassia fistula. And the percentage of wood consumption of *Cassia fistula* was 3.77% as shown in table 1. These results are important for estimating the repellent quality and anti-feedant property of different wooden species against M. obesi. It is also helpful to determine the foraging behavior of the termites. Feeding preferences in descending order based on wood consumption as a quantitative parameter documented are as follows: Cordiamyxa (93.01%), Moringa oleifera (92.83%), *Bombax ceiba (87.98%), Bambusa bamboo (84.61% , Syzygium cumini (77.33%), Albizia lebbeck (76.48%), Dalbergia sissoo (67.86%), Psidium guajava (65.96%), Pinus roxburghii (62.69%), Acacia nilotica (58.16%) ,Bauhinia variegata (55.79%), Azadirachta indica (51.13%), Eucalyptus camaldulensis (49.28%), Mangifera indica (47.29%), Heterophragma adenophyllum (33.00%), Cassia fistula* (3.77%) as shown in table 1 & Table 2.

(a)Pinus roxburghii / Cordiamyxa

(b) Bombax ceiba / Dalbergia sisso

(C) Bauhinia variegata /Syzygium cumini

(d) Acacia nilotica / Azadirachta indica

(e) *Bambusa bamboo /Psidium guava*

(f) Mangifera indica / Cassia fistula

(g) *Heterophragma adenophylum*

(h) Eucalyptus camaldulensis / Moringa oleifera /Albizia lebbeck

Figure 10 Damage caused by the workers and feeding preferences *Microtermes obesi* on eight different pairs of wooden blocks when exposed under choice natural field conditions after 3 months. (a)*Pinus roxburghii / Cordiamyxa(b) Bombax ceiba / Dalbergia sisso © Bauhinia variegata /Syzygium cumini (d) Acacia nilotica /Azadirachta indica (e) Bambusa bamboo /Psidium guava (f) Mangifera indica /Cassia fistula (g)Heterophragma adenophylum (h) Eucalyptus camaldulensis /Moringa oleifera.*

Choice field trials

A chain of paired choice field trials were also conducted to compare the preference of *M.obesi* for *Pinus roxburghii* verses *Cordiamyxa* (PR/CM), Bombax *ceiba* versus *Dalbergia sissoo* (BC/DS), *Bauhinia variegata* versus *Syzygium cumini* (BV/SC), *Acacia nilotica* versus *Azadirachta indica* (AN/AI), *Bambusa bamboo* versus *Psidium guajava* (BB/PG), *Mangifera indica* verses *Cassia fistula* (MI/CF), *Heterophragma adenophyllum* verses *Albizia lebbeck* (HA/AL), *Eucalyptus camaldulensis* versus *Moringa oleifera* (EC/MO).

Wooden blocks of different trees were arranged to evaluate the mass loss of woods by comparing one pair of woods with another wood pair. This comparison of feeding preference was thought to be more suggestive choice for termites feeding that termites came across in their natural environment. Consequently, termites had the choice of eating either the wooden block they select to feed or they avoid from non-preferred or un palatable wooden blocks as shown in table 3. Statistically values in different wooden blocks in pairs showed significant results at 95 and 99% confidence interval as shown in table 3, 4 & 5.

Table 1 Mean consumption (g) and percentage of consumption of 16 different timber species exposed to *Microtermes obesi* in choice feeding bioassay after 3 months under natural field conditions

Wood used	Wood consumption (g)	Mass loss (%)
Pinus roxburghii (Chir)	19.71[a]	62.69
Cassia fistula (Amaltas)	1.41[b]	3.77
Eucalyptus camaldulensis (Safaida)	16.63[a]	49.28
Syzygium cumini (Jaman)	22.49[c]	77.33
Bauhinia variegata (Kachnar)	20.51[d]	55.79
Mangifera indica (Mango)	14.40[a]	47.29
Heterophragma adenophyllum (Beripata)	12.01[e]	33.00
Moringa oleifera (Sohanjna)	33.04[f]	92.83
Acacia nilotica (Kakar)	22.98[d]	58.16
Cordiamyxa (Lasora)	39.15[g]	93.01
Bombax ceiba (Sumbal)	11.42[e]	87.98
Azadirachta indica (Neem)	18.65[a]	51.13
Dalbergia sissoo (Shesham)	24.70[d]	67.86
Albizia lebbeck (Shreen)	26.21[d]	76.48
Psidium guajava (Gauva)	27.29[d]	65.96
Bambusa bamboo (Bamboo)	18.43[d]	84.61

Table 2 Feeding preference of *Microtermes obesi* ($\overline{X}$ ± S.E) under choice trials in the field conditions after three months

Wood used	$\overline{X}$ ± S.E	t-value	Significance
Pinus roxburghii (Chir)	11.73 ± 3.046	11.73	5.274
Cassia fistula (Amaltas)	35.97 ± .214	35.97	.370
Eucalyptus camaldulensis (Safaida)	17.11 ± 2.233	17.11	3.868
Syzygium cumini (Jaman)	6.59 ± .831	6.59	1.439
Bauhinia variegata (Kachnar)	16.25 ± .664	16.25	1.132
Mangifera indica (Mango)	16.05 ± ,625	16.05	1.082
Heterophragma adenophyllum (Beripata)	24.38 ± .639	24.38	1.106
Moringa oleifera (Sohanjna)	2.55 ± .015	2.55	.026
Acacia nilotica (Kakar)	16.53 ± .804	16.53	1.392
Cordiamyxa (Lasora)	2.94 ± .276	2.94	.478
Bombax ceiba (Sumbal)	1.56 ± .405	1.56	.702
Azadirachta indica (Neem)	17.82 ± .702	17.82	1.217
Dalbergia sissoo (Shesham)	11.40 ± 2.703	11.40	4.682
Albizia lebbeck (Shreen)	8.06 ± .965	8.06	1.672
Psidium gauva (Gauva)	14.08 ± .427	14.08	.739
Bambusa bamboo (Bamboo)	3.35 ± .029	3.35	.050

Table 3 Feeding preference of *Microtermes obesi (*$\overline{X}$ ± S.E*)* at 95% significance level on eight wooden pairs under choice trials in the field conditions after three months

Wood used	$\overline{X}$ ± S.E	t-value	Significance level 95%
PR-CM	8.79667 ± 3.01715	2.916	.100
BC-DS	9.83667 ± 3.10725	3.166	.087
BV-SC	9.65333 ± 0.46642	20.697	.002
AN-AI	1.28333 ± 1.42595	.900	.463
BB-PG	10.72667 ± 0.41898	25.602	.002
MI-CF	19.91667 ± 0.81948	24.304	.002
HA-AL	16.32000 ± 1.52333	10.713	.009
EC-MO	14.56000 ± 2.24849	6.475	.023

Statistically values in different wooden blocks in pairs showed significant results at 95 and 99 % confidence interval as shown in table 4.4.

Table 4 Feeding preference of *Microtermes obesi* ($\overline{X}$ ± S.E) at 99 % significance level on eight wooden pairs under choice trials in the field conditions after three months

Wood used	$\overline{X}$ ± S.E	t-value	Significance level 99%
PR-CM	8.79667 ± 3.01715	2.916	.100
BC-DS	9.83667 ± 3.10725	3.166	.087
BV-SC	9.65333 ± .46642	20.697	.002
AN-AI	1.28333 ± .46642	.900	.463
BB-PG	10.72667 ± .41898	25.602	.002
MI-CF	19.91667 ± .81948	24.304	.002
HA-AL	16.32000 ± 1.52333	10.713	.009
EC-MO	14.56000 ± 2.24849	6.475	.023

Table 5 Mean ($\overline{X}$ ± S.E) wood consumption/ wood mass loss (g) in eight wooden pairs when subjected to the workers of *Microtermes obesi* for paired choice tests series to compare the feeding preferences of *M.obesi* for *Pinus roxburghii* verses *Cordiamyxa* (PR/CM), *Bombax ceiba* versus *Dalbergia sissoo* (BC/DS), *Bauhinia variegata* versus *Syzygium cumini* (BV/SC), *Acacia nilotica* versus *Azadirachta indica* (AN/AI), *Bambusa bamboo* versus *Psidium guava*(BB/PG),*Mangifera indica* verses *Cassia fistula* (MI/CF), *Heterophragma adenophyllum* verses *Albizia. lebbeck* (HA/AL), *Eucalyptus camaldulensis* versus *Moringa oleifera* (EC/MO) in 12-week choice trials under field conditions

*Comparison	Wood 1	Wood 2
PR-CM	11.7333 ± 3.04473	2.9367 ± .27606
BC-DS	1.5600 ± .40509	11.3967 ± 2.70335
BV-SC	16.2467 ± .65351	6.5933 ± .83109
AN-AI	16.5333 ± .80367	17.8167 ± .70243
BB-PG	3.3533 ± .02906	14.0800 ± .42673
MI-CF	16.0533 ± .62462	35.9700 ± .21385
HA-AL	24.3833 ± .63855	8.0633 ± .96534
EC-MO	17.1100 ± 2.23330	2.5500 ± .01528

*Note: Each wooden block was paired with a block of another species (wood 1 / wood 2) under natural field conditions. Difference in mass loss for each pair of wood blocks indicated by asterisk at 0.05 is significantly different (paired comparison t test).

In a choice of two woods Microtermes obesi showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 11 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on Cardiamyxa and less on *Pinus roxburghi* and the volume of wood consumed were significantly different(t=2.916) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (93.01%) Cardiamyxa and 62.69% *Pinus roxburghi*. The percentage consumption of different wooden blocks was 93.01% and 62.69% respectively (Figure 11).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 12 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Bombax ceiba* and less on *Dalbergia sisso* and the volume of wood consumed were significantly different(t=3.166) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (87.98%) *Bombax ceiba* and 67.86% *Dalbergia sisso*. The percentage consumption of different wooden blocks was 87.98% and 67.86% respectively (Figure 12).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 13 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Syzygium cumini* and less on *Bauhinia variegate* and the volume of wood consumed were significantly different (t=20.697) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (77.33%) *Syzygium cumini* and 55.79% *Bauhinia varigata*. The percentage consumption of different wooden blocks was 77.33% and 55.79% respectively (Figure 13).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 14 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Acacia nilotica* and less on *Azadirachta indica and* the volume of wood consumed were significantly different(t=.900) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (58.16%) *Acacia nilotica* and 51.13% *Azadirachta indica*. The percentage consumption of different wooden blocks was 58.16% and 51.13% respectively (Figure 14).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 15 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Bambusa bamboo* and less on *Psidium guava* and the volume of wood consumed were significantly different(t=25.602) as represented in the figure as indicated by alphabets a and b. Microtermes obesi consumed (84.61%) *Bambusa bamboo* and 65.96% *Psidium guava*. The percentage consumption of different wooden blocks was 84.61% and 65.96% respectively (Figure 15).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 16 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Mangifera indica* and less on *Cassia fistula* and the volume of wood consumed were significantly different(t=24.304) as represented in the figure as indicated by alphabets a and b. Microtermes obesi consumed (47.29%) *Mangifera indica* and 3.77% *Cassia fistula*. The percentage consumption of different wooden blocks was 47.29% and 3.77% respectively (Figure 16).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 17 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Albizia lebbeck* and less on *Heterophragma adenophyllum* and the volume of wood consumed were significantly different(t=10.713) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (76.48%) *Albizia lebbeck* and 33.00% *Heterophragma adenophyllum*. The percentage consumption of different wooden blocks was 76.48% and 33.00% respectively (Figure 17).

In a choice of two woods *Microtermes obesi* showed instinct of having preferred wood when a comparison was offered between two different woods. Figure 18 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Moringa oleifera* and less on *Eucalyptus camaldulensis and* the volume of wood consumed were significantly different(t=6.475) as represented in the figure as indicated by alphabets a and b. *Microtermes obesi* consumed (92.83%) *Moringa oleifera* and 49.28% *Eucalyptus camaldulensis*. The percentage consumption of different wooden blocks was 92.83% and 49.28% respectively (Figure 18).

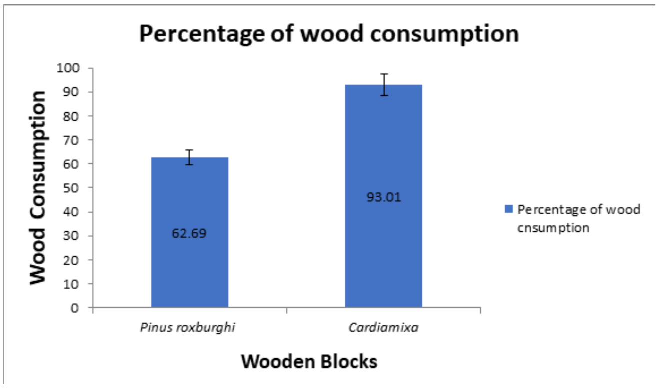


Figure 11 Shows comparison of wood consumption by *Microtermes obesi* between *Cardiamyxa* and *Pinus roxburghi.*

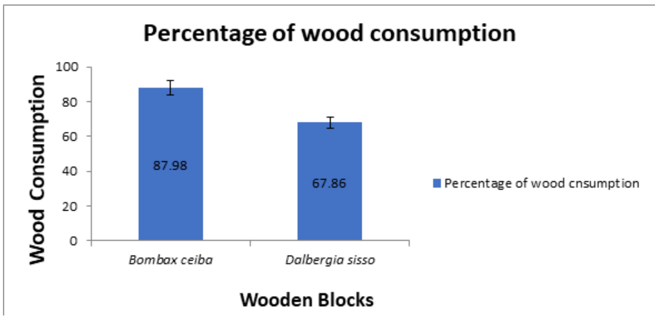


Figure 12 Shows comparison of wood consumption by *Microtermes obesi between Bombax ceiba and Dalbergia sisso.*

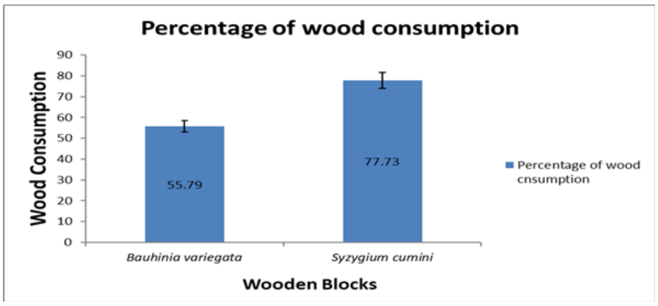


Figure 13 Shows comparison of wood consumption by *Microtermes obesi* between *Syzygium cumini* and *Bauhinia variegata.*

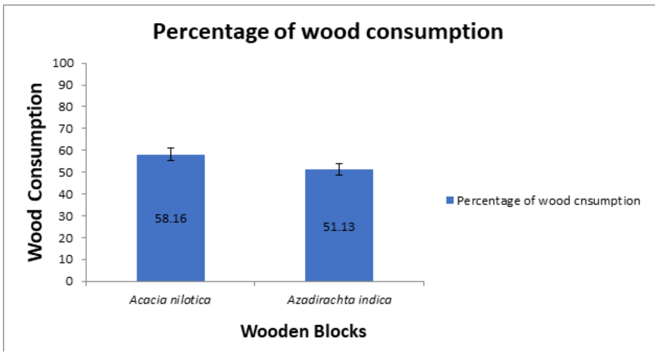


Figure 14 Shows comparison of wood consumption by *Microtermes obesi* between *Acacia nilotica* and Azadirachta *indica.*

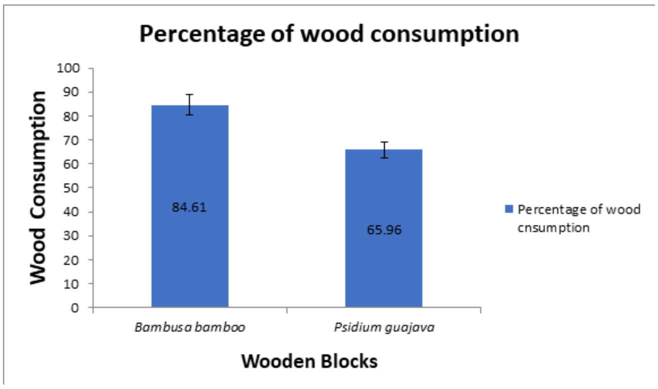


Figure 15 Shows comparison of wood consumption by *Microtermes obesi* between *Bambusa bamboo* and *Psidium guava*.

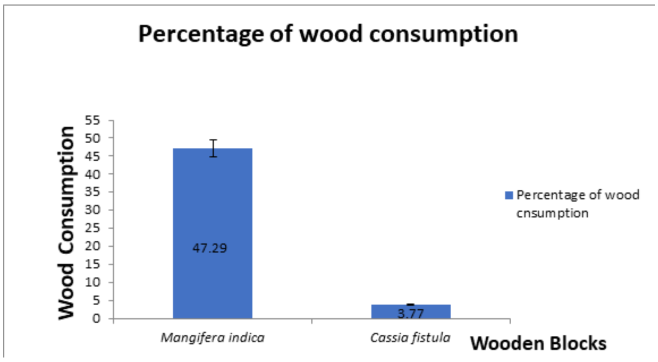


Figure 16 Shows comparison of wood consumption by *Microtermes obesi* between *Mangifera indica and Cassia fistula*.

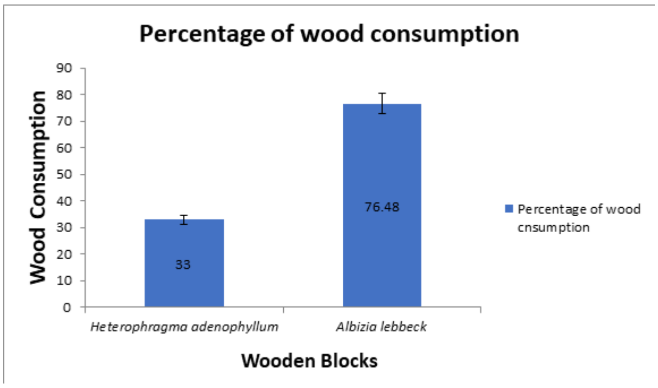


Figure 17 Shows comparison of wood consumption by *Microtermes obesi* between *Albizia lebbeck* and *Heterophragma adenophyllum*.

Citation: Rasib KZ, Nadeem AD. Feeding preference of pestiferous *Microtermes obesi* (*Blattodea: termitidae*) on different timbers under natural condition. *Biodiversity Int J.* 2022;6(1):11‒21. DOI: 10.15406/bij.2022.06.00202

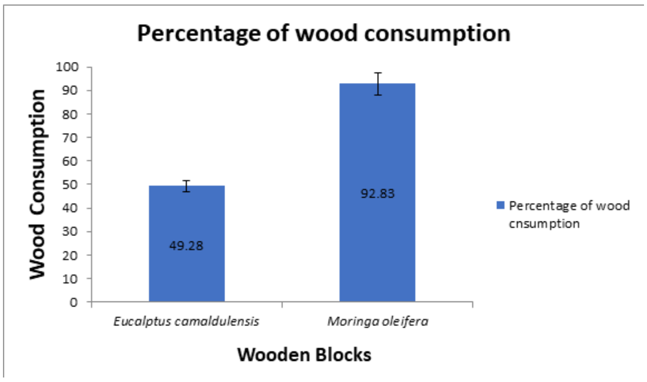


Figure 18 Shows comparison of wood consumption by *Microtermes obesi* between *Albizia lebbeck* and *Heterophragma adenophyllum*.

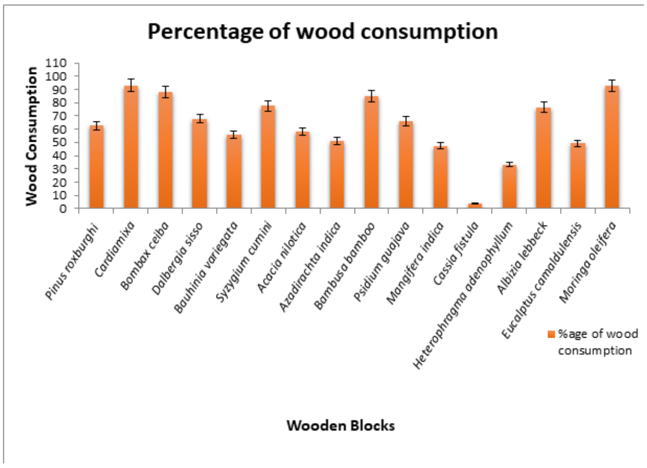


Figure 19 Shows comparison of wood consumption by Microtermes obesi on sixteen different wooden species.

In a choice of sixteen woods *Microtermes obesi* showed instinct of having preferred wooden block, when a comparison was offered between different woods Figure 19 shows that combination of different wooden blocks to *Microtermes obesi* exhibited maximal feeding on *Cordiamyxa* (93.01%) and less on *Cassia fistula* (3.77%0). Feeding preferences in descending order based on wood consumption as a quantitative parameter documented are as follows: *Cordiamyxa* (93.01%), *Moringa oleifera* (92.83%), *Bombax ceiba* (87.98%), *Bambusa bamboo* (84.61%), *Syzygium cumini* (77.33%), *Albizia lebbeck* (76.48%), *Dalbergia sissoo* (67.86%), *Psidium guava* (65.96%) , *Pinus roxburghii* (62.69%), *Acacia nilotica* (58.16%) ,*Bauhinia variegata* (55.79%), *Azadirachta indica* (51.13%), *Eucalyptus camaldulensis* (49.28%), *Mangifera indica* (47.29%), *Heterophragma adenophyllum* (33.00%), *Cassia fistula* (3.77%) (Figure 19).

Discussion

Feeding preferences of *Microtermes obesi* to sixteen different wooden species were studied as termite control efforts could only be planned by having profound knowledge of feeding tendencies and feeding behavior of termites. To control termite a basic knowledge is of prerequisite for termite control. Termite experts have perceived that some of the wood types are termite resistant. Wood[14] and Wolcott[15] reported that specific termite's repellant chemicals present in wood and causes resistance against termite's attack on wood. Many symbiotic protozoans in termites are affected directly or indirectly by toxic chemicals of wood. Mauldin.[16] reported the vide ranging population of protozoa in termites that were exposed to different twenty-one American heartwood samples. High concentration of lignin and hardness does not prevent woods from being consumed by dry wood termite species.[15]

But, Behr[17] described that hardness of wood and its resistance to termite's attack have strong association among them than that of other dry-wood termite species. In Pakistan and other developing countries, the termite control cost may exceed the cost of renewing or replacing the damaged lumber, as compare to severe termite's infestation of wooden structures which is almost tolerated. However, in the big cities of Pakistan due to improvement in living standards and increase in income, this trend has changed and people are now aware of termite's damage to their valued wooden structures 53 species of termites in Pakistan have been described, but amongst them only eleven species have cause economic damage to wooden constructions Iqbal and Saeed.[18] The main purpose of this study was to determine the wood species with the highest levels of resistance and exposure to attack by *M.obesi*. Significant work has been carried out by different researchers in Pakistan to study the feeding preferences of termites.[19,20] However, in Pakistan, indigenous information related to termites shown that wooden plants species such as, "*P. roxburghii, D. sissoo* and *T. grandis*" retain anti termite materials Martawijaya.[21] But the current study results differ from those of the former work regarding *M. obesi*, which even consumed a substantial amount of wood of *Cordiamyxa* and *Moringa oleifera*, whereas *Cassia fistula* was reasonably more resistant. However, it is also important to mention that the extractive contents of wood are also one of the parameters determining the resistance against the damaging agents. The current study results reveals that the natural wood resistance protects it from termite attack. Also, the results favour a former report that higher specific gravity of the timber species is related to the natural resistance of wood to termite attack.[22,23] Feeding preferences of timber and its resistance will modify with the chemical constitution of woods, rigidity, and lignin contents. The ecology of feeding area of termites is also affected by the presence of organic chemicals, such as phenol, quinones, terpenoids and lignin at high concentrations. The pH of timber contents is also important in its resistance. Starch and sugar contents of sapwood generally desired over heartwood by termites. Therefore, they developed chemical defense mechanisms of native trees are more resistant to termite attack and to protect themselves against the action of termites. In immature trees and crops the chemical defense mechanisms are more prevalent thus forming them less vulnerable to termite's attack. The quantity of these chemicals in trees can vary from the outer to inner layers. Cracks that formed in the bark of older trees & the resistant chemicals might not be exists in the cracked bark of the trees may probably permitting attack of termites on the trees, Pearce.[24] Likewise, Chaudhry[25] examined the resistance that naturally exists in several wooden species against the *C. heimi* attack. They more over studied that the survival of the *C. heimi* on the saw dust of twelve commonly found wooden species of Pakistan in the laboratory. Based on the long life of soldiers and workers, *T. grandis* and *C. deodara* were stated for having resistance against termite's attack, whereas the most susceptible species were, "*Picea smithiana, Salmalia malabarica, and Acacia pindrow*". In Jhang and Faisalabad districts a survey was conducted on termite's infestation on the trees linked with agricultural farm discovered that Shesham (*D. sissoo*) & Kikar (*A. Arabica*) are very common trees located besides the border of various crops farm. These trees are the source of timbers to the agriculturalists for many purposes. The research work was carried in district Lahore, where the most commonly planted tree is *P. euramericana*. The commercial applications and thick canopy of *P. euramericana* makes it most favorite cultivated plant. Due to this reason *P. euramericana* is extremely infested by *C. heimi* in the Lahore region. visited 7 Punjab forests to study the infestation of termites on commercially significant species of trees. They detected twelve species of termites from the soil, dead wooden logs, living woods and trees. The major prevalent wooden species of visited forests were as following, "*A. arabica, Tamarix articulata, D. sissoo, M. alba, E. camaldulensis, Melia azedarach, Abies pindrow, T. grandis*, dry grass, *Bombax cieba*, *Arjun terminalia*, *Prosopis sp*., *Ficus religiosa, M. indica, A. lebbeck, Phyllanthus emblica, S. cumini, Broussonetia papyrifera, Dendrocalamus strictus, S. malabarica, Populus sp*. and rubber trees". In these seven forests of Punjab province, the signs of subterranean termite's infestations was shown by twenty percent of numb (dead) wooden logs and tree branches, however *C. heimi* caused greater damage to, "*D. sissoo, T. articulata, A. pindrow, M. indica, A. lebbeck, M. alba and Populus sp*". But, minimum termite's damage was examined in *T. grandis* and *S. cumini*, which is reliable with our results. Similarly, like many other species of termites *C. heimi* is able to locate or identify its palatable wooden species. The current study demonstrates that the information of feeding preferences earlier to bait is essential for the assessment of behavior towards feeding and nutritive ecology of the species of termites. On the bases of termites feeding preference, the utmost palatable wooden species can be carefully chosen as an attractant material to increase efficacy of the bait for active program of termites baiting. The maximum palatable species of woods in the current study can be used for the detection of termite in natural condition where other numerous reasonable means of food are too accessible. Weight loss, consumption and survival rate of different woods were assessed. *Cordiamyxa* was found to be the most vulnerable species of wood and *Cassia fistula* the most resistant one. Sixteen different combination of woods were used in choice natural field conditions; maximum feeding of *Microtermes obesi* was noted in *Cordiamyxa* and *Moringa oleifera* (39.15-33.00 g). On the other hand, minimum feeding was noted in *C.fistula* (1.41 g) and *Heterophragma adenophyllum* (24.38 g). Under choice natural condition of field, lowest feeding was noted in *C. fistula* (1.41 g) and maximum feeding was observed in *Cordiamyxa* (39.15 g). Feeding preferences in descending order based on consumption of wood as a quantitative parameter documented are as follows: *Cordiamyxa* > *Moringa oleifera* > *Bombax ceiba* > *Bambusa bamboo* > *Syzygium cumini* > *Albizia lebbeck* > *Dalbergia sissoo* > *Psidium guava* > *Pinus roxburghii* > *Acacia nilotica* > *Bauhinia variegata* > *Azadirachta indica* > *Eucalyptus camaldulensis* > *Mangifera indica* > *Heterophragma adenophyllum* > *Cassia fistula.*

Conclusion

In conclusion, pairing of susceptible and resistant wooden species can prevent wood damage by termites. And it could be a significant measure to prevent infestation of woods by termites. The separation of food niches hinders inter specific competition for food and, therefore, allows overlapping of foraging territories. Thus, differences in feeding preferences may be one of the major factors, which lead to the effective separation of different termite species present in the same area. Since food choices are almost always available to termites in nature, bait attractiveness is of critical importance for bait performance. Feeding bioassays for effective baiting strategy could prove beneficial in improving the efficiency of bait while choosing the most palatable wooden species. Studies in future on extracts of the most resistant wood in eco-friendly termite's management can reveal the analysis of resistant components & wood resistance could be an actual goal. Results of the studies like this are also important for the assessment of preserving treatment levels required for the protection of timber species in the regions with high infestation of termites and also for the identification of naturally durable wooden species that may not need preservative treatment. Natural durability of woods is an area of increasing curiosity that can help to minimize the application of industrial chemicals in the environment.

The practical implications of the studies also show that under natural conditions the plants growth in such patterns be encouraged to reduce the extent of termite damage under greater natural diversity. The study will also corroborate the strategies in managing termite attack under natural conditions.

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Conflicts of interest

The author declares that there is no conflict of interest.

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