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(54) Title: A HERBAL ANTI-TERMITE FORMULATION

(57) Abstract: A herbal anti-termite formulation consisting of one or more edible and or non-edible seed oil alone or infused with one or more herbs, by-products of essential oil and cashew industry and natural active substances of one or more plant parts, wherein the formulation specifically contains active extracts of *Azadirachta indica*, *Pongamia pinnata* and genus of *Acorus*, *Allium*, and *Vitex*, sesame oil infused with peel of genus *Citrus*, pitch (residual matter of essential oil industry), and cashew nut shell liquid. (by product of cashew industry), along with suitable carrier solvents and emulsifiers for termite, fire-ants and wood decaying killing or control.



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1. TITLE OF THE INVENTION

A Herbal Anti-Termite Formulation

2. DESCRIPTION**(a) FIELD OF INVENTION**

5 The present invention is a composition for the treatment of wood to preserve and protect it from fire ants, termites and any other wood borers. More particularly, the present invention is for the protection of wood and wood objects from wood attacking and decaying by an insect which is harmful to wood such as termites and *Lyctus brunneus* Stephens which damage a building or a furniture made of wood and also by a wood decaying microorganism
10 including a brown-rot fungus such as *Fomitopsis palustris* and a white-rot fungus such as *Trametes versicolor* and also against a dirt by a wood-staining fungus such as *Aspergillus niger* and *Aureobasidium pullulans*, as well as a method and use for producing the same for both agriculture land and in-house use.

(b) DESCRIPTION OF THE RELATED ART

15 Many products are available for protecting wood. However, these products usually do not last for more than a year before an additional coat must be reapplied.

It has been known for many years that woods of various types may be preserved by chemical treatment. For example, lumber has been treated with: creosote to prevent decay and to prevent termite attack; pentachlorophenol and compounds of copper, chromium and
20 arsenic have been used as preservatives. However, many of these treatments result in undesirable coloration of the treated wood, the need to use high temperatures and/or pressures in the treatment process, the use of toxic or environmentally dangerous chemicals, lack of penetration case hardening, etc. Moreover the treating agents do not satisfactorily protect the wood against leaching of the preservation or treating agent,
25 especially wood used for exterior applications and/or for contact with moisture.

The amount of deterioration of wood exposed to exterior environmental condition varies widely, depending on the type of wood involved and the location of the structure containing the wood. While some woods such as redwood and cedar have better than average weathering characteristics they still become discolored and damaged due to prolonged
30 exposure to the environment. Additionally, wood exposed to a humid environment, such as that found in the southern United States, is susceptible to attack by mold and other

microorganisms, whereas wood exposed in dry climate and at high altitudes is susceptible to damage from ultraviolet light.

Subterranean termites cause millions of dollars in damages to wooden structures in the United States. This destruction is not limited to wooden structures alone--many commercial termiticides used to combat these pests are potential environmental contaminants and carcinogens. For example, the most common method of subterranean termite infestation prevention, which involves applying a chemical termiticide to a structure's peripheral grounds, often, leads to soil and water contamination when applied improperly. Accordingly, it is desirable to find new means for controlling termites which do not pose such potential hazards.

Heretofore various chemicals have been used for anti-termite treatment, such as those derived from creosote oil, organic phosphor, azole, carbamate, pyrethroid, naphthalene, copper and the like. Some of those chemicals exhibit strong toxicity and are subject to such problems that they cannot be used for treating the parts with which men would contact, or, even when used for treating the parts which normally are not contacted by men, such as house foundations, the workers have to pay meticulous care not to contact the chemicals themselves or the wood which were given the anti-termite treatment. Furthermore, the effect of many of those chemicals has low durability and hence the treatment has to be repeated at an interval of several years, which gives rise to a cost problem. Still in addition, there is a possibility that the volatilized or eluted chemicals are detrimental to the environments or human bodies.

Three principal methods have been used in the past to control *Coptotermes*: (1) chemical and physical barriers to prevent termites from attacking wood, (2) wood preservatives and termiticides used to protect infested or susceptible wood, and (3) destruction of a termite colony by excavation of the nest. The extensive use of chemical barriers and termiticides has generated public concern over environmental safety.

One most widely used approach, which has been employed to control the fire-ant is chemical pesticides. While these have had minimal success, they also pose environmental hazards. The government has imposed restrictions on some chemicals in an effort to protect the environment from the harmful toxic effects these chemicals produce. Among the chemicals banned or restricted in use by governments are: DDT, Chlorodane, Lindane, Aldrin,

Heptachlor, Dieldrin, and Mirex. Mirex was found to be one of the most effective fire ant killers, however since its use has been banned in the United States; the fire ant population has increased rapidly.

5 There are still a number of commercial pesticide products on the market currently. These pesticides are typically contact poisons and are effective in killing a wide variety of insects. One which specifically targeted fire ants is AMDRO (registered trademark of American Cyanamid Company). This product is a delayed-action pesticide advertised to be effective against fire ants because it is eventually ingested by the queen. When the queen is killed, the colony vanishes and the mound is destroyed. However, AMDRO has a number of drawbacks.
10 AMDRO loses much of its effectiveness following contact with rain or humidity. This is a serious shortcoming, since much of the domain of imported fire ants is along the southern coastal states of the United States where rainfall is plentiful. AMDRO also has a short shelf life after the container has been opened.

15 Many of the commercial pesticides carry a warning label that they are hazardous to humans and some, such as Orthene (manufactured by The Ortho Group), state that protective gloves should be used when handling. With this in mind some patents have been issued to inventors for fire ant pesticides which contain natural ingredients such as pine oil and even animal waste. For example: U.S. Pat. No. 4,891,222 to Eichhoefer, Jan. 2, 1990, and U.S. Pat. No. 5,118,506 also to Eichhoefer, Jun. 2, 1992 both contain pine oil as one of the major
20 ingredients. U.S. Pat. No. 6,699,489 to Driscoll, Mar. 2, 2004, uses animal waste along with other ingredients. A need still remains though for a product which is both effective against fire-ants and termites and at the same time is non-toxic to humans, biodegradable and environmentally safe.

25 The search for a new repellent or termiticide is difficult because studies have shown that termites show unexpected sensitivity to chemicals, sensitivity that differs from that of other insects. For example, phenoxyethanol has been shown to be a trail-following substance; and naphthalene, a toxicant for most insects, was found to be used as fumigant by termites for their nests at concentrations that would kill fire ants. See U.S. Pat. No. 5,874,097; J. Chen et al., "Isolation and identification of 2-phenoxyethanol from a ballpoint pen as a trail-following
30 substance of *Coptotermes formosanus* Shiraki and *Reticulitermes* sp., J. Entomol. Sci., vol.

33, pp. 97-105 (1998); and J. Chen et al., "Termites fumigate their nests with naphthalene," *Nature*, vol. 392, pp. 558 (1998).

Natural termite repellent chemicals have also been described. The nature leaves of *Cinnamomum osmophloeum* Kaneh, and *C. zeylanicum* B1 have been found to impart
5 termite resistance. The main components of oil extracted from these two species were cinnamic aldehyde and eugenol, respectively, with eugenol exhibiting the greater termite resistance activity. See Tien-shu Lin et al., "The effect of *Cinnamomum* spp. oils on the control of the termite *Coptotermes formosanus* Shiraki," *Taiwan For. Res. Inst. New Series*, vol. 10, pp. 459-464 (1995). Additionally, the woods of Alaska-cedar, redwood, and teak
10 were found to be resistant to Formosan subterranean termites. Although the termites did feed on the woods, it was only to a very limited extent. See J. K. Grace, "Natural resistance of Alaska-cedar, redwood, and teak to Formosan subterranean termites," *Forest Products Journal*, vol. 44, pp. 41-45 (1994); and R. P. Adams, "Cedar Wood Oil--Analyses and Properties," in *Modern Methods of Plant Analysis--Oils and Waxes*, H. F. Linskens and J. F. Jackson, eds., Spring Verlag, pp. 159-173 (1991).
15

There is a need for a composition for the treatment of wood which will withstand weathering for an extended period of time before re-application is required. It is also desirable that the treatment prevents or inhibits discoloration, drying, curling and splitting of the treated wood. It is also desirable that the composition fills the pores of the wood to be
20 treated without leaving a surface film build-up, thus avoiding the need for surface preparation before re-application of the composition. Further there is also need to have a wood treatment formulation which is non-toxic and environmental friendly.

(c) BRIEF SUMMARY OF THE INVENTION

It is an object of the disclosed formulation is to produce a product which is economical, easy
25 and safe to use, and which is effective in killing and controlling fire-ants and termites.

A further object of the present formulation is to produce a product which is environmentally safe, non-toxic and biodegradable in the environment with no adverse effects.

It is still a further object of the present formulation to provide various compositions and methods for use of the present formulation which kills fire-ants and termites, in which
30 compositions are preferably in liquid form, but can also be in granular, spray, or paste form.

A further object of this invention is to provide a product which can be used as a barrier to prevent ants of all kinds from entering homes or commercial buildings and wood structures.

Thus, the formulation of present invention comprises at least one member selected from a plant, an extract of the plant, and an ooze of the plant, each containing an insecticidal component, wherein the plant belongs to at least one genus selected from:

1. the genus *Allium*
2. the genus *Acorus*
3. the genus *Citrus*
4. the genus *Vitex*

10 The extract may be obtained by extracting the plant parts by any polar solvents but preferably by 90 % methanol and water.

As described, since the formulation of the present invention comprises ingredients derived from a plants specified above, it is highly safe and capable of exterminating and repelling insects (e.g., injurious insects) without adversely affecting the ecosystem.

15 The present invention relates to the herbal formulation that consists active extracts of *Azadirachta indica*, *Pongamia pinnata* and genus of *Acorus*, *Allium*, and *Vitex*, sesame oil infused with peel of genus *Citrus*, pitch (residual matter of essential oil industry), and cashew nut shell liquid (by product of cashew industry), along with suitable carrier solvents and emulsifiers which in cumulative effect controls termites, white ants, wood borers and wood
20 decaying fungi when applied in an effective amount to the locus affected by mentioned targeted organisms.

All the described ingredients are active against the targeted organism and exhibit cumulative effect when applied as combined formulation. The synergistic effect of the described combined formulation acts much better than the effect when each ingredient is applied
25 individually. This may be better explained by some experiments described here (details are given in Examples).

Contact test

Ten gram of each active extract mentioned in the description, were added to 1 kg silica sand to allow the sand to carry 1 % of the concentrate and then some water was added to

maintain the moisture and humidity of sand. The entire mass was then transferred to a glass vessel to which workers of termites were released for observation

Sample	Time after treatment				
	1 h	2 h	4 h	1 day	2 day
	number of termites showing respective conditions (Normal-knockdown-death)				
Karanj extract (karanjin min 10000 ppm)	7-3-0	5-4-1	3-6-1	2-6-2	4-3-3
Neem extract (500 ppm)	8-1-1	7-2-1	6-3-1	5-2-3	2-4-4
Sesame oil (infused with orange peel)	5-4-1	3-5-2	2-6-2	2-4-4	4-4-2
Allium extract	7-3-0	6-4-0	5-4-1	3-3-4	2-3-5
<i>Acorus</i> rhizome extract	6-4-0	5-5-0	4-5-1	3-4-3	3-4-3
<i>Vitex</i> leaf extract	7-3-0	7-3-0	5-4-1	4-5-1	4-5-1
Pitch	8-2-0	6-3-1	6-3-1	4-4-2	3-4-3
CNSL	6-2-2	5-3-2	5-2-3	2-4-4	2-5-4
<i>Product</i> (combined formulation)	2-5-3	0-4-6	0-0-10	0-0-10	0-0-10
Control	10-0-0	10-0-0	10-0-0	10-0-0	10-0-0

All the extracts were tested for their individual efficacy up to 2 days and then compared with
5 the claimed product that has combination of all active ingredients. All extracts exhibited

some activity against targeted pest but the claimed product exhibited much increased mortality and known down effect than active ingredients showed individually. This experiment confirms the existence of synergistic activity among the used active ingredients.

Attacking Inhibition Test

- 5 The disclosed formulation can be mixed with water to form an emulsion @ 5 ml/L, with which a Whatman No.1 filter paper of 1 cm×1 cm in size was impregnated shortly prior to drying at room temperature. This filter paper sample was placed in a population of the workers of *termites* (100 workers per sample), which were observed for the attacking (ingestion) inhibition. Filter paper impregnated with water was served as control.
- 10 Percentage damage done by termites and protection exhibited by active ingredients and claimed formulation estimated by attacking inhibition test

Sample	% damage (approx.)	% protection
Karanj extract (karanjin min 10000 ppm)	28	72
Neem extract (500 ppm)	36	64
Sesame oil (infused with orange peel)	15	85
Pitch	24	76
CNSL	15	85
Allium extract	15	85

<i>Acorus</i> rhizome extract	18	82
<i>Vitex</i> leaf extract	48	52
<i>Product</i> <i>applied for</i> <i>patent</i>	0	100
Control	100	0

All the extracts were tested for their individual efficacy for their repellent effect against termites and then compared it with the claimed product that has combination of all active ingredients. All extracts exhibited some protection from the pest but the claimed product exhibited full protection than active ingredients showed individually. This experiment confirms the existence of synergistic activity among the used active ingredients.

(d) DETAILED DESCRIPTION OF THE INVENTION

The disclosed invention is a herbal formulation for treating wood to preserve the appearance and condition of the treated wood from termite, fungus and other wood decaying organisms. The formulation, as defined in the present invention, also effectively controls termites in agriculture fields.

The present formulation avoids the problems of previously mentioned chemical pesticides, which can harm the environment and are hazardous to handle, by using ingredients which are easily accessible and environmentally safe and when used in the manner described here are lethal to fire-ants and termites.

The disclosed formulation is effective for controlling fire ants, termites and other wood borers. The ingredients of the present formulation are as follows:

- a) One or more edible/non-edible seed oils;
- b) By-product of essential oil and cashew industry; and
- c) Active extracts of one or more plant parts, along with suitable diluents, emulsifiers and carrier solvents.

Neem extract:

Neem (*Azadirachta indica*) belongs to family meliaceae.

- Neem extract is obtained by cold pressing of dried neem seeds as heat dried extraction degrades the heat labile active compounds of neem seeds.
- 5 • Oil thus obtained was filtered and extracted with a polar solvent preferably 90 % Methanol (at least three times)
- Aqueous alcoholic extract was then filtered and pooled
- Filtered extract was concentrated under reduced pressure up to 20-25 % of the total extract
- 10 • Azadirachtin content of concentrated extract was checked by RP-HPLC and maintained not below 1000 ppm
- Semi liquid concentrate was then used for product formulation

Karanj extract:

15 Karanj oil: Karanj (*Pongamia pinnata*) is a deciduous tree and belongs to family Fabaceae.

- Its oil is obtained by cold press extraction.
- Oil thus obtained was filtered and extracted with a polar solvent preferably 90 % Methanol (at least three times)
- Aqueous alcoholic extract was then filtered and pooled
- 20 • Filtered extract was concentrated under reduced pressure up to 20-25 % of the total extract
- Karanjin and Pongamol content of concentrated extract was checked by RP-HPLC and maintained not below 10000 and 5000 ppm, respectively.
- Semi liquid concentrate was then used for product formulation

Sesame oil:

- Sesame oil (also known as gingelly oil or til oil) is an edible vegetable oil derived from sesame seeds, obtained from *Sesamum indicum* of family Pedaliaceae
- Sesamol and sesamin present in sesame oil repel termites and also acts as natural synergist to enhance the activities of other active compounds

Pitch (Essential oil residue):

30

The world production of essential oils is estimated about 1, 10,000 tons where India stands at number three position with a share of about 16-17 %. Oil is processed by fractional distillation or by synthesis. The sole purpose of the processing is value addition. After separation of different chemicals mainly terpenes as main ingredients, the residual part is usually not used though it contains useful ingredients like phenol and terpenes. For example processing of Palma Rosa oil produces about 5- 10 % of residual matter that is used for incense sticks which is a low value use. Due to large production of essential oils very huge amount of this residual matter (pitch) is obtained that may be better used for its insecticidal activities.

Cashew nut shell liquid

Cashew Nut Shell Liquid (CNSL) is a versatile by-product of the cashew industry. The nut has a shell of about 1/ 8 inch thickness inside which is a soft honey comb structure containing a dark reddish brown viscous liquid. It is called cashew nut shell liquid, which is the pericarp fluid of the cashew nut. It is often considered as the better and cheaper material for unsaturated phenols. The production potential for the product is very high.

Allium spps.

Allium, commonly known as Onion belongs to family Alliaceae. It contains flavonols, glucosides, sulfides, Vitamin C and folic acid.

- Peel of onion is cut and shade dried then extracted with hot water (at least thrice)
- Extracts were filtered, pooled and then concentrated under reduced pressure to obtained light brown semi solid residual concentrate

Acorus calamus

Acorus calamus is the botanical name of the plant more commonly known as calamus. Other common names of calamus include calamus root, flag root, muskrat root, sweet calomel, sweet flag, sweet sedge, and many other names.

It has long been classified as belonging to the Araceae family, but more recent studies suggested that it should be placed in its own family. Although not everyone agrees, many now consider calamus to be a member of the Acoraceae family. It contains α and β -

asarones, calamendiol, α -selinene, α -calacorene, calamusenone, camphone and shyobunone.

- Rhizome of calamus was shade dried and cut in to small pieces.
- Cut pieces was then put under steam distillation to extract essential oil
- 5 • The water decoction of calamus rhizomes, obtained after essential oil extraction, was then used for the product formulation.

Citrus spp.

10 It is a small flowering tree growing to about 10 meters tall with evergreen leaves, commonly known as Orange and belongs to family Rutaceae. It possesses d-limonene of which exhibits repellent activity against termites

- Peel of orange fruit was peeled off and shade dried
- Dried peel was then infused in sesame oil at the ratio of preferably but not restricted to 1: 5
- 15 • Sesame oil infused with citrus peel extract was then used for the product formulation

Vitex spp.

20 *Vitex negundo* (commonly known as Nirgundi) is a large, aromatic shrub belongs to family Lamiaceae. It leaves contains casticin, isoorientin, chrysophenol D, luteolin, p-hydroxybenzoic acid and D-fructose.

- Whole plant of vitex was shade dried and ground to powder
- Ground powder was then extracted at least thrice with Aqueous alcohol (90 % menthanol)
- Extracts were filtered, pooled and then concentrated under reduced pressure to obtained semi solid residual concentrate to be used for the formulation.

25 (e) DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present disclosed formulation provides a synergistic and residual herbal composition for controlling termites, white ants and other wood borers comprising, in admixture of one or more non edible tree borne seed oils infused with herbs, one or more plant extracts, residue of one plant essential oil such as that of species of *Cymbopogon*, preferably Palma Rosa, by product of Cashew nut industry with a suitable carrier and optionally with a suitable surface active agent.

In particular, the disclosed formulation is prepared to be water miscible by using solvent that is water miscible, preferably with low toxicity to mammals such as human and livestock. When used as a termiticide, a water- miscible composition is safe to human than that formulated with highly volatile organic solvents but not limited to only xylene, kerosene, aromax or diesel.

Examples of such water miscible solvents include, but are not limited to, ethanol, methanol, butanaol, acetone, alkyl ketones, ethyl acetate, methyl acetate, dimethyl sulfoxide, dimethyl acetamide, benzyl alcohol, ethylene glycol diethyl ether, ethylene glycol dimethyl ether and tetrahydrofuran. The water- miscible solvent may be used in combination to render the formulation water- miscible.

In another embodiment, the formulation has naturally occurring insecticidal compounds such as azadirachtin and that azadirachtin is present in neem oil in not less than 1000 ppm concentration.

In other embodiment, the naturally occurring insecticidal compounds karanjin and pongamol present in karanj oil are not less than 10000 and 5000 ppm.

Extracts of *Acorus*, *Vitex* and *Allium* described above can be obtained by any conventional methods. For example, a plant listed above may be cut, dried and ground if necessary and then extracted with a suitable extraction solvent autoclave or a pressurizing reactor at room temperature or with heating, and then filtered if necessary and then concentrated to obtain the extract.

Cashew nut shell liquid (CNSL) is a by-product of cashew industry. It may be obtained either by extraction in hot oil or in solvents or by mechanical expulsion from the shells.

CNSL consists chiefly of naturally produced phenolic compounds-Anacardic acid (about 90%) and Cardol (about 10%).

An extraction solvent may for under atmospheric pressure or under pressure in an example be water; an alcohol including a monohydric alcohol such as methanol, ethanol, n-propanol, i-propanol, n-butanol, i-butanol, sec-butanol, t-butanol, n-octanol, 2-butyl
5 octanol, tridecanol, iso-tridecanol, 2-hexyl 1-octanol, 2-butyl-1-decanol, 2-hexyl-1-decanol, lauryl alcohol and cyclohexanol as well as a dihydric or polyhydric alcohol such as ethylene glycol, propylene glycol and glycerin; an ether such as ethyl ether, propyl ether, isopropyl ether, dimethoxyethane, a cyclic ether, for example, dioxane and tetrahydrofuran, a
10 mono- or dialkylene glycol monoalkyl ether, for example, ethylene glycol monomethyl ether; a ketone such as acetone, methyl ethyl ketone, methyl isobutyl ketone and cyclohexanone; an ester such as ethyl acetate, butyl acetate and n-butyl laurate; a halogenated hydrocarbon such as carbon tetrachloride, chloroform, dichloromethane and 1,2-dichloroethane; an aliphatic hydrocarbon such as hexane and octane; an alicyclic
15 hydrocarbon such as cyclohexane and cycloheptane; an aromatic hydrocarbon such as benzene, toluene and xylene; a nitrile such as acetonitrile; a carboxylic acid such as formic acid, acetic acid, oleic acid, octanoic acid, nonanoic acid, decanoic acid and iso-decanoic acid; an aprotic polar solvent such as N,N-dimethylformamide, dimethylsulfoxide, pyridine and the like. Any of these solvents may be employed alone or in combination with each
20 other.

As a wood preservative, the invented formulation can be applied to an insect harmful to a wood, a wood rot fungus and a wood-staining fungus, especially to termites that are insects harmful to wood. The insect harmful to a wood, which is a target of a wood preservative according to the invention, may for example be any of those listed below.
25 Examples include insects of Isoptera, Coleoptera and Hymenoptera. Examples of the Isoptera insects described above are Rhinotermitidae termites such as *Reticulitermes speratus* and *Coptotermes formosanus* and *Kalotermitidae* termites such as *Cryptotermes domesticus* and *Incisitermes minor*. Examples of the coleoptera insects described above are Cucujidae insects such as *Lyctus brunneus* stephens, *Lyctus linearis* and *Lyctus sinensis*,
30 Anobiidae insects such as *Nicobium hirtum*, *Ernobius mollis*, *Ptilineurus*

marmoratus and *Sculptotheca hilleri*, Bostrychidae insects such as *Dinoderus minutus*, *Dinoderus japonicus*, *Rhizophorthera dominica* and *Heterobostrychus hamatipennis*, Cerambycidae insects such as *Stromatium longicorne*, Rhynchophoridae insects such as Rhynchophory, Scolytidae insects such as *Xyleborus saxeslni*, as well as Buprestidae insects and Curculionidae insects. Examples of the Hymenoptera insects described above are Anthophoridae insects such as *Xylocopa appendiculata* circumvolans and Formicidae insects such as *Camponotus obscuripes*. A wood-decaying fungus as a target of the wood preservative according to the invention is any of various fungi including a brown-rot fungus, for example, *Fomitopsis palustris*, *Coniophora puteana*, *Gloeophyllum saepiarium*, *Gloeophyllum trabeum* and *Serpula lacrymans* and a white-rot fungus, for example, *Trametes versicolor*. A wood-staining fungus as a target of a wood preservative of the invention may for example be *Aspergillus niger* and *Aureobasidium pullulans*. When a wood preservative of the invention is employed for controlling a harmful insect, especially a house insect such as termites, and also against a wood rot fungus and wood staining fungus, then a highly efficient control is possible at a low dose.

In a method for protecting a wood using an inventive wood preservative, the wood preservative described above is applied to a site of the invasion by or the occurrence of a harmful insect or a wood decaying or staining fungus, such as corners of kitchens, bathrooms, living rooms, floors, under the floors, ceilings, house foundations, pillars, walls, wooden ware such as furniture and soils. Such a method for applying a wood preservative includes various modes, for example application, dusting, immersion, infusion, mixing and spraying, depending on the site of the invasion by or the occurrence of a wood-eating harmful insect and a wood rotting or staining microorganism. Such a treatment method is not limited particularly as long as a wood can be protected, and it is also possible to employ, in addition to a direct application to a wood, an application to a basal heat insulating material or a composition may be buried in a soil. It is also possible to mix the present formulation, for example, with an adhesive, which is then applied to plywood, a composite board or a woody board. When the present formulation is applied into a soil, it may be sprayed onto the surface of the soil or into a groove formed on the soil or may be mixed with the soil. A wood preservative can also be utilized effectively in such a way that

it is incorporated into a sheet substrate such as synthetic resin sheets, papers or fabrics by means of application, impregnation or kneading to form a sheet formulation, which is then mounted on or applied to a site of the invasion by or the occurrence of a harmful insect described above.

- 5 As a wood preservative, the present formulation is excellent in preventing the ingestion of a wood by an insect harmful to the wood and preventing the onset and the growth of a wood-rot fungus or a wood-staining fungus. It is highly safe to humans and animals without exerting no adverse effect on the environment.

Accordingly the disclosed formulation may further comprise an emulsifier or a surfactant.

- 10 Any emulsifier may be used to enhance the solubility and/ or stabilize the formulation, preferably an emulsifier that is generally regarded as safe for agricultural and household uses.

Optionally, the disclosed formulation may further comprise a combination of emulsifiers with complementary hydrophilic and hydrophobic parameters. For examples, the emulsifiers may be a combination of non- ionic surfactant and anionic surfactant.

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Examples of non-ionic surfactant include, but are not limited to, polyoxyethylated alkylphenols, polyoxyethylated sorbitan monoesters, TWEEN 20-80, ethylene oxide. Examples of anionic emulsifier include, but are not limited to alkyl, alkyl- aryl and aryl sulfonates, sulfates and phosphate, soaps.

- 20 The concentration of the surfactant that is included in the formulation may preferably be between about 0.1 %- 20 %(w/v), more preferably be between 1 %- 15 %(w/v) to get concentration of emulsifier/ surfactant around 0.1-0.01 % upon dilution with water at the time of spray application.

- 25 The stability of the disclosed formulation, before dilution and application may preferably be between 80-100 %, preferably 90-100 % and retained pesticidal activity after two years of storage at room temperature.

The present disclosed herbal formulation was evaluated for its bio activity against wood borers and termites as stated below and also compared with commercially insecticidal product available in the market.

5 The synergistic formulation of the present invention is further illustrated in the following, non-limiting Examples. The Examples are illustrative of various embodiments only and do not limit the claimed invention regarding the materials, conditions, weight ratios, process parameters and the like recited herein.

10 Descriptions of well-known embodiments and processing techniques are omitted so as to not unnecessarily obscure the formulation herein. The examples used herein are intended merely to facilitate an understanding of ways in which the formulation herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the formulation herein.

Example 1

- 15 1. The product may be formulated by following the steps written flow:
- I. Extracts of karanj, neem, *Allium*, *Acorus*, and *Vitex* were put together in a proper vessel (vessel A) and mixed by stirring at 30-40 °C.
 - II. Orange peel infused in hot sesame oil, was then mixed with neem and karanj extract with the help of suitable solvents and emulsifiers.
 - 20 III. Cashew nut shell liquid (CNSL) is diluted with suitable organic solvent in a separate container (vessel B), and pitch was mixed in it.
 - IV. Solution of pitch and cnsl was then transferred into vessel A and the whole solution was stirred for around half an hour at 35-40 °C.
 - V. The solution was then left for 8-10 h preferably overnight to check any
25 residual matter and then filtered.

The resulted filtered formulation is useful for the control of termites, white ants and other wood borers. when applied to a termite, white ants and other wood borers affected locus and prevent wood, wood structures from attack of termites, fire ants, other wood borers and wood decaying fungus along with suitable carriers, emulsifiers or diluents. i.e. for
30 treating wood structures etc. preferably use 5 % of product formulation with deodorized

kerosene, aromax or any other wood penetrating solvents, and for agriculture protection, preferably use the formulation at the rate of 5 % and make the emulsion in water.

Note: percentage of usage may vary according to the severity of damage if already done previously.

5 Table 1: Ingredients and their range of %s

Ingredients	Suggested %s
Karanj extract (karanjin min 10000 ppm) (A)	10-35
Neem extract (500 ppm) (B)	10-30
Sesame oil (infused with orange peel) (C)	2-10
Allium extract (D)	1-10
Acorus rhizome extract (E)	1-4
Vitex leaf extract (F)	1-5
Pitch (G)	1-10
CNSL (H)	1-10
Solvent/emulsifier	QS

Example 2: Anti-termite activity test (Contact test)

Ten gram of each active extract mentioned in the examples, were added to 1 kg silica sand to allow the sand to carry 1 % of the concentrate and then some water was added to maintain the moisture and humidity of sand. The entire mass was then transferred to a glass vessel to which workers of termites were released for observation (Table 2)

Table 2: Results of contact test performed as described above

Sample	Extraction Solvent	Time after treatment

		1 h	2 h	4 h	1 day	2 day
		number of termites showing respective conditions (Normal-knockdown-death)				
Karanj extract (karanjin min 10000 ppm)	(90 % Methanol)	7-3-0	5-4-1	3-6-1	2-6-2	4-3-3
Neem extract (500 ppm)	(90 % Methanol)	8-1-1	7-2-1	6-3-1	5-2-3	2-4-4
Sesame oil (infused with orange peel)	dissolved in IPA or nBA	5-4-1	3-5-2	2-6-2	2-4-4	4-4-2
Allium extract	water	7-3-0	6-4-0	5-4-1	3-3-4	2-3-5
<i>Acorus</i> rhizome extract	water	6-4-0	5-5-0	4-5-1	3-4-3	3-4-3
<i>Vitex</i> leaf extract	(90 % methanol)	7-3-0	7-3-0	5-4-1	4-5-1	4-5-1
Pitch	dissolved in IPA or nBA	8-2-0	6-3-1	6-3-1	4-4-2	3-4-3
CNSL	dissolved in IPA or nBA	6-2-2	5-3-2	5-2-3	2-4-4	2-5-4
<i>Product applied for patent</i>	Emulsion in water	2-5-3	0-4-6	0-0-10	0-0-10	0-0-10
Control	-	10-0-0	10-0-0	10-0-0	10-0-0	10-0-0

Example 3: Attacking Inhibition Test

Similarly to Experiment 2, samples/ingredients shown in Table 1 were extracted with the respective solvent shown in Table 1 to obtain product.

This product was mixed with water to form an emulsion @ 5 ml/L, with which a Whatman No.1 filter paper of 1 cm×1 cm in size was impregnated shortly prior to drying at room temperature. This filter paper sample was placed in a population of the workers of termites (100 workers per sample), which were observed for the attacking (ingestion) inhibition. Filter paper impregnated with water was served as control.

The attacking inhibition test performed as described above gave the results shown in Table 3.

Table 3: Table showing Percentage damage done by termites and protection exhibited by active ingredients and claimed product estimated by attacking inhibition test

Sample	Extraction Solvent	% damage (approx.)	% protection
Karanj extract (karanjin min 10000 ppm)	(90 % Methanol)	28	72
Neem extract (500 ppm)	(90 % Methanol)	36	64
Sesame oil (infused with orange peel)	dissolved in IPA or nBA	15	85
Pitch	dissolved in IPA or nBA	24	76
CNSL	dissolved in IPA or nBA	15	85
Allium extract	Water	15	85
<i>Acorus</i> rhizome extract	water	18	82
<i>Vitex</i> leaf	(90 % methanol)	48	52

extract			
<i>Product applied for patent</i>	Emulsion in water	0	100
Control	-	100	0

Example 4: Wood decaying Fungal Growth Inhibition Test

A 5 w/w % acetone solution of each compound/ingredients shown in Table 1 was prepared. In the solution, a No.1 filter paper of 1×1 cm in size was immersed, taken out and then air-dried. To the resultant filter paper, about 2 ml of the suspension of a spore mixture of the 4 wood-decaying microorganisms was sprayed, and the growth of the fungi on a 2% agar medium in a petri dish (90 mm dia.) was observed for 3 days. The results are shown in Table 4.

Staining Fungi Employed:

10 *Aspergillus niger*

A. flavus

Penicillin funiculosum and *Gliocladium virens*

Table 4: Anti-fungal activity of used ingredients after 3 days

Sample	Fungal growth			
	<i>A. niger</i>	<i>A. flavus</i>	<i>Penicillin funiculosum</i>	<i>Gliocladium virens</i>
Karanj extract (karanjin min 10000 ppm)	++	++	+	++

Neem extract (500 ppm)	+++	++	++	+++
Sesame oil (infused with orange peel)	+	+	+	++
Allium extract	++	+	++	++
Acorus rhizome extract	+	+	++	++
Pitch	++	+	+	++
CNSL	+	+	++	+
Vitex leaf extract	+++	++	++	++
<i>Product applied for patent</i>	No Growth	No Growth	No Growth	No Growth
Control	++++	++++	++++	++++

++++; 90-100 % growth, +++; 70-89 % growth, ++; 40-69 % growth, +; 5-39, and 0-4 considered as No growth

5. CLAIMS

I claim:

1. A formulation consisting of a) one or more edible and or non-edible seed oil alone or infused with one or more herbs b) by-products of essential oil and cashew industry c) natural active substances of one or more plant parts, wherein the formulation specifically contains active extracts of *Azadirachta indica*, *Pongamia pinnata* and genus of *Acorus*, *Allium*, and *Vitex*, sesame oil infused with peel of genus *Citrus*, pitch (residual matter of essential oil industry), and cashew nut shell liquid (by product of cashew industry), along with suitable carrier solvents and emulsifiers.
2. The formulation according to claim 1, wherein the extracts are obtained by extracting whole plant but preferably rhizomes of *Acorus calamus*, whole plant but preferably bulb of *Allium cepa* and whole plant but preferably leaves of *Vitex negundo* with any polar solvent, while whole fruit but preferably peel of *Citrus sinensis* is infused in hot sesame oil.
3. The formulation as claimed in the claim 1, wherein the said composition contains preferably but not restricted to 10-35 % extract of karanj, 10-30 % of neem extract, 2-10 % of sesame oil infused with orange peel, 1-4 %, extracts of *Acorus* spp., 1-10 % *Allium* spp., 1-5 % *Vitex* spp. and 1-10 % of essential oil residue (pitch) and Cashew nut shell liquid both.
4. The formulation as claimed in the claim 1, wherein the active extract of karanj possesses active ingredients karanjin and pongamol and the concentrations of a.i. are not less than 10000 and 5000 ppm, respectively
5. The formulation as claimed in the claim 1, wherein the active extract of neem possesses natural active ingredient azadirachtin and the concentrations of a.i. is not less than 1000 ppm.

6. The formulation as claimed in the claim 1, wherein the formulation is also active against wood decaying fungal pathogens and is useful for protecting wood and wood objects from the same.
- 5 7. The formulation as claimed in the claim 1, wherein the pitch (essential oil residue) is preferably but not restricted to palma rosa.
8. The formulation as claimed in the claim 2, wherein the said extracts of plants are extracted by using any polar solvent preferably by 90 % methanol.
- 10 9. The formulation as claimed in the Claim 1, contains an effective amount of one or more edible/non-edible seed oils, byproduct of essential oil and cashew industry and active extracts of one or more plant parts.
- 15 10. The formulation as claimed in the Claim 1, is termitically active and able to control termites, fire ants and other wood borers when applied to a termite affected locus and prevent wood, wood structures from attack of termites, fire ants, other wood borers and wood decaying fungus along with suitable carriers, emulsifiers or diluents.
- 20 11. The process wherein the formulation as claimed in claim 1, is composed pursuing the following steps:
- I. Extracts of karanj, neem, *Allium*, *Acorus*, and *Vitex* were put together in a proper vessel (vessel A) and mixed by stirring at 30-40 °C;
 - II. Orange peel infused in hot sesame oil, was then mixed with neem and karanj extract with the help of suitable solvents and emulsifiers;
 - 25 III. Cashew nut shell liquid (CNSL) is diluted with suitable organic solvent in a separate container (vessel B), and pitch was mixed in it;
 - IV. Solution of pitch and cnsl was then transferred into vessel A and the whole solution was stirred for around half an hour at 35-40 °C; and
 - 30 V. The solution was then left for 8-10 h preferably overnight to check any residual matter and then filtered.