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(54) Title: INSECT REPELLENTS

(57) Abstract: The present invention provides an insect repellent fragrance comprising; (a) at least 10% by weight of the insect repellent fragrance of geraniol; (b) at least 10% by weight of the insect repellent fragrance of diethyl phthalate; and (c) at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate; wherein the insect repellent fragrance comprises at least 60% by total weight of the insect repellent fragrance of (a), (b) and (c). The insect repellent fragrance surprisingly demonstrates effective repellency, particularly against cockroaches, and more particularly against both German and American cockroaches.



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Insect Repellents

Field of the Invention

The present invention relates to fragrances, particularly insect repellent fragrances, to products comprising such fragrances and to a method of repelling insects.

Background of the Invention

Insects have long been known to be a nuisance to humans, and for some insect genera, a health hazard.

Many common types of household insects such as cockroaches, e.g. American cockroaches (*periplaneta americana*) and German cockroaches (*blattella germanica*), are classified as pests and significant effort has been made to control or eradicate them. A variety of chemical compounds have been discovered, e.g. N,N-diethyl-meta-toluamide, which are efficacious in repelling cockroaches. Such chemical compounds are used in the household by applying or spraying them to surfaces of walls, floors, cabinets, containers, rugs, upholstery and carpeting, and in potential nesting places for these insects, such as inside walls and between floors. Chemical compounds have been used together with hard surface cleaners (EP-A-0619363) and wax floor polishes (US-A-3018217).

It is known in the art that essential oils and synthetic fragrance ingredients (also known as perfume materials) can repel insects. Further, use of these ingredients may be advantageous compared with the use of chemical compounds in terms of presenting lower toxicity to mammals. WO 96/08147 describes an insect repellent composition comprising at least one active ingredient from the group of compounds consisting of: 1,2,3a,4,5,5a,6,7,8,9,9a,9b-dodecahydro-3a,6,6,9a-tetramethylnaphtho [2,1-b] furan (AMBERLYN™); 4-(tricyclo [5.2.1.0^{2,6}] decylidene-8) butanal (DUPICAL™); 1-ethoxy-1-(2'-phenylethoxy) ethane (EFETAAL™); acetyl cedrene (LIXITONE™); and propylidene phthalide. The compositions

are described as preferably used to repel biting insects, such as mosquitoes, and in particular members of the genus *Aedes*.

Perfume materials, or fragrances, with repellent properties to either American cockroaches (*periplaneta americana*) e.g. as disclosed in WO 00/19822 and Ngoh S.P. *et al.*, *Pestic. Sci.*, 1998, 54, p261, or German cockroaches (*blattella germanica*) e.g. as disclosed in JP 2207004, are known. However, typically, it is difficult to formulate a complete fragrance which effectively repels cockroaches, particularly German cockroaches, and more particularly, repels both German and American cockroaches, possibly together with other crawling insects e.g. ants.

Summary of the Invention

In one aspect, the present invention provides an insect repellent fragrance comprising;

- (a) at least 10% by weight of the insect repellent fragrance of geraniol;
- (b) at least 10% by weight of the insect repellent fragrance of diethyl phthalate; and
- (c) at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate;

wherein the insect repellent fragrance comprises at least 60% by total weight of the insect repellent fragrance of (a), (b) and (c).

The present invention is based on the appreciation that insect repellent fragrances of the invention surprisingly demonstrate effective repellency against cockroaches, particularly German cockroaches (*blattella germanica*), and more particularly against both German and American cockroaches (*blattella germanica* and *periplaneta americana*).

By "insect repellent fragrance" as used herein is meant a fragrance comprising the specified fragrance ingredients generally (but not necessarily) having an odour that is considered pleasant or attractive, and which has an insect repellent effect. One convenient procedure by which the insect repellent effect can be tested and measured involves incorporating the insect repellent fragrance into a liquid polish, with 3.0ml of the liquid polish being evenly applied to half the area (i.e. 300mm x 600mm) of a vinyl flooring test surface of total area 600mm x

600mm, which is then divided into nine channels (30mm x 600mm) so that half of each channel (30mm x 600mm) is treated and half is untreated, the liquid polish being allowed to dry for approximately one hour before at least five insects are introduced into each channel and allowed to acclimatise to the conditions for about ten minutes, after which, i.e. at $t = 0$ hours, the movements of the insects are measured by video recorder. An insect repellent fragrance initially, i.e. at $t = 1$ hour, preferably repels from the treated area at least 60%, more preferably at least 65%, most preferably at least 70%, of the insects.

The term "insect" as used herein is intended to encompass insects which typically crawl e.g. cockroaches such as German cockroaches (*blattella germanica*) and American cockroaches (*periplaneta americana*) as well as ants e.g. from the genera *lasius flavus*, *lasius niger* and *monomorium pharoanis*. Preferably, fragrances in accordance with the present invention are used to repel cockroaches, particularly German cockroaches and more particularly both German and American cockroaches.

Typically, the insect repellent fragrance comprises at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate (PtBCHA), preferably at least two, more preferably at least three, and even more preferably at least four of these fragrance ingredients. Conveniently, when present, insect repellent fragrances as defined herein comprise at least 1% linalol, at least 2% limonene, at least 2% and preferably greater than 3% citronellal, at least 2% and preferably greater than 3% terpinolene, and at least 3% p-tertiary butyl cyclohexyl acetate by weight of the insect repellent fragrance.

The insect repellent fragrance may optionally be admixed with further excipients such as one or more further fragrance ingredients to obtain an overall pleasing fragrance with effective repellent activity, diluents, fixatives, and a further suitable solvent, or mixtures thereof.

Other excipients which may advantageously be present in the insect repellent fragrances in accordance with the invention are: aldehyde C11 (undecylenic aldehyde); aldehyde iso C11 (GIV); allspice oil; allyl cyclohexyl propionate; amyl salicylate; amylcinnamic aldehyde; anethole; anisic alcohol; anisic aldehyde; Applinal (Q) (Applinal is a Trade Mark); bay oil; benzyl acetate; benzyl benzoate; benzyl cinnamate; benzyl propionate; benzyl salicylate;

Bourgeonal (Q) (Bourgeonal is a Trade Mark); brahmanol; camphor powder synthetic; cedarwood virginian; cedrenol; cedryl acetate; Celestolide (IFF) (Celestolide is a Trade Mark); cineole; cinnamic alcohol; cinnamic aldehyde; cinnamon leaf oil; cinnamyl acetate; cis-3-hexenol; citral; citronella oil; citronellol; citronellyl acetate; citronellyl oxyacetaldehyde; clove oil; coriander oil; coumarin; cuminic aldehyde; cyclamen aldehyde; decanal; 9-decenol; dibenzyl ether; dibutyl phthalate; dihydromyrcenol; dimethyl anthranilate; dimethyl phthalate; Dimycretol (IFF) (Dimycretol is a Trade Mark); diphenyl methane; diphenyl oxide; dimethyl benzyl carbonyl acetate; dodecanol; dodecanal; elemi oil; ethyl methyl phenyl glycidate; ethyl cinnamate; Ethyl Safranate (Q) (Ethyl Safranate is a Trade Mark); ethyl vanillin; eugenol; evergreen oils (pine oils etc.); gamma-nonolactone; gamma-undecalactone; geranium bourbon; geranyl acetate; geranyl formate; gum benzoin; heliotropin; Hercolyn D (HER) (Hercolyn D is a Trade Mark); hexyl benzoate; hexylcinnamic aldehyde; hexyl salicylate; hydratropic aldehyde dimethyl acetal; hydroxycitronellal; hydroxycitronellal dimethyl acetal; indole; isobornyl acetate; isopropyl myristate; iso-cyclocitral (GIV, IFF); jasmacyclene; jasmin oil; lavandin abrialis; lavender oil; Lilial (GIV) (Lilial is a Trade Mark); linalyl acetate; menthol laevo; methyl anthranilate; methyl cedryl ketone; methyl dihydrojasmonate; methyl ionone; methyl myristate; methyl naphthyl ketone; methyl salicylate; moss treemoss; musk ketone; nerol; nerolin bromelia; neryl acetate; nonanal; oakmoss absolute; octanal olibanum resinoid; para-cresyl phenylacetate; para-methoxyacetophenone; patchouli oil; peppermint oil; petitgrain oil; 2-phenoxyethanol; phenoxyethyl iso butyrate; phenylethylacetate; phenylethyl alcohol; phenylethyl butyrate; phenylethyl phenylacetate; pimento oil; pinene, alpha; resinoid benzoin siam; rose oil; rosemary oil; sandalwood oil; terpineol; tetrahydrolinalol; Tetrahydromuguol (IFF); thyme red; undecanal; vanillin; verbena oil; vetyvert bourbon; yara and ylang ylang.

Compounds are obtainable from the suppliers as indicated below: for those compounds labelled "(Q)", - Quest International; "(IFF)" - International Flavours & Fragrances, Inc.; "(GIV)" - Givaudan; "(HER)" - Hercules B.V.

The insect repellent fragrance may optionally include other known insect repellents, and preferably known insect repellent fragrance ingredients.

Suitable known insect repellents for use herein include N,N-diethyl-m-toluamide (DEET); N,N-diethylbenzamide; citronella; Tolu balsam; Peru balsam; Eucalyptus oil; Huon pine oil; camphor; cypress oil; galbanum; dibutyl phthalate; dimethyl phthalate; 1,2,3a,4,5,5a,6,7,8,9,9a,9b-dodecahydro-3a,6,6,9a-tetramethylnaphtho[2,1-b]furan; 4-(tricyclo[5.2.1.0^{2,6}]decylidene-8)butanal; 1-ethoxy-1-(2'-phenylethoxy)ethane; acetyl cedrene; propylidene phthalide; citral diethyl acetal available under the trade mark "CITRATHAL"; tricyclodecenyl allyl ether available under the trade mark "FLEUROXENE"; 2-(2-methylpropyl)-4-hydroxy-4-methyltetrahydropyran available under the trade mark "FLOROSA"; N-methyl-N-phenyl-2-methylbutanamide available under the trade mark "GARDAMIDE", 4-isobutyrate-3-methoxybenzaldehyde available under the trade mark "ISOBUTAVAN"; 1-hydroxy-2-methoxy-4-propenyl benzene; 2,2,7,7-tetramethyltricyclo[6.2.1.0^{1,6}]undecan-5-one available under the trade mark "ISOLONGIFOLANONE"; 7-formyl-5-isopropyl-2-methylbicyclo(2.2.2)oct-2-ene available under the trade mark "MACEAL"; 3-methyl-5-phenylpentanal available under the trade mark "MEFRANAL"; alpha iso methyl ionone; myrcenyl acetate available under the trade mark "NEOBERGAMATE"; 10-isopropyl-2,7-dimethyloxaspiro[4.5]3,6-decadiene available under the trade mark "NEOCASPIRENE"; tricyclo[5.2.1.0^{2,6}]dec-4-en-8-yl 2,2-dimethylpropanoate available under the trade mark "PIVACYCLEN"; 2-phenylethyl pivalate available under the trade mark "PIVAROSE" and 2,4-dimethyl-4-phenyltetrahydrofuran available under the trade mark "RHUBAFURAN".

Insect repellent fragrances in accordance with the invention are preferably incorporated in products for application to a surface e.g. floors, walls, counters, sinks, cupboards, furniture or doors etc.. The invention in a further aspect therefore provides a product comprising an insect repellent fragrance in accordance with the invention.

Suitable and preferred products include for example, hard surface cleaners, pastes and polishes e.g. furniture polish, floor polish and floor paste in typically liquid or solid e.g. wax form. A particularly preferred product is a floor polish.

Preferably, the products defined herein above comprise between 0.01% to 20% and more preferably 0.1% to 10% by weight of the product of an insect repellent fragrance in accordance with the present invention.

In an even further aspect, the invention provides a product comprising an insect repellent fragrance, wherein the product comprises;

- (a) at least 0.025% by weight of the product of geraniol;
- (b) at least 0.025% by weight of the product of diethyl phthalate; and
- (c) at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate; and

wherein the product comprises at least 0.15% by total weight of the product of (a), (b) and (c).

The product will typically comprise further suitable adjuvants appropriate to the nature of the product. Suitable adjuvants may include wax e.g. paraffin, carnauba, ceresin wax etc., resins, plasticizers, water, surfactants e.g. anionic, cationic, nonionic, amphoteric compounds, builders, fluorescent brighteners, antistatic agents, antibacterial agents, fungicides, foaming agents, anti-foams, flow promoters, suspending agents, and anti-gelling agents.

Insect repellent fragrances according to the present invention in their simplest form as a fragrance, or as part of a product, may be applied to a surface, including floors, furniture, walls etc. by spraying, for instance as an aerosol or by a pump action, by brushing, by wiping, for instance from an impregnated cloth or with an applicator, pouring etc. on the surface to be treated.

Thus, in an even further aspect, the invention provides a method of repelling insects from a surface comprising the step of applying to the surface an effective amount, typically from 0.001 to 1.000g/m², of an insect repellent fragrance, preferably a product comprising from 0.01% to 20% by weight of the product of an insect repellent fragrance, in accordance with the present invention.

In an even further aspect the invention provides the use of an insect repellent fragrance in accordance with the present invention for repelling cockroaches, particularly German cockroaches (*blattella germanica*) and/or American cockroaches (*periplaneta americana*).

The invention is illustrated by way of the following non-limiting examples, and with reference to the accompanying drawing, in which:

Figure 1 is a schematic representation of the arrangement of a test area used to determine the repellency of a fragrance to insects of interest, the test area being divided into nine equal channels, with half of the total area treated with a fragrance (as shown by the spotted shading) and half untreated.

Examples

The repellency of fragrances in accordance with the present invention, particularly to German cockroaches (*blattella germanica*) and American cockroaches (*periplaneta americana*), was demonstrated as described below. For comparison, fragrances not in accordance with the present invention were also prepared and tested using the same protocol.

Fragrances 1 to 4 in accordance with the present invention, and comparative fragrances 5 to 7, were prepared in the proportions indicated in the table below. All percentages are by weight.

Ingredient	Frag. 1	Frag. 2	Frag. 3	Frag. 4	Frag. 5	Frag. 6	Frag. 7
Citronellal	4	6	12		2		
Geraniol	24	36	12	12			
Terpinolene	4	6	12			2	
Diethyl phthalate	20	16	16	20	20	20	20
Benzyl acetate	5	5	5	5	6	5	5
Hexyl salicylate	5	3	3	3	3	3	3
Lavandin	10	10	10	6	9	6	6
Linalol	5	5	5	4	4	5	4
Methyl dihydrojasmonate	3	3	5	2	2	3	2
Terpineol	5	4	6	5	5	5	5
Iso bornyl acetate	4	3	5	9	9	11	12
Limonene	5	3	5	15	15	16	18
Cedarwood Virginian	1			4	5	4	5

PtBCHA	3		3	10	15	15	15
Diphenyl methane	2		1	5	5	5	5
Total	100	100	100	100	100	100	100

The fragrances prepared were then incorporated into a self-shining liquid floor polish i.e. a floor polish which dries with a shiny finish and does not typically require buffing, the formulation of which is indicated below:

Ingredient	% w/w
Hoescht-Wachs (Hoescht)	10.20
Demineralised water (boiling)	20.40
Demineralised water (room temperature)	63.70
Licomer A53 conc. (Hoescht) (acrylate polymer)	4.50
Bronidox L (Henkel) (5-bromo-5-nitro-1,3 dioxane)	0.20
Lutensol ON70 (BASF) (Synthetic C10 oxo-alcohol with 7 ethylene oxide units)	0.50
Fragrances 1 to 7	0.50

LICOMER, BRONIDOX and LUTENSOL are all trade marks.

Each self-shining liquid floor polish comprising one of fragrances 1 to 7 was tested for its ability to repel German cockroaches (*blattella germanica*) and American cockroaches (*periplaneta americana*) according to the following protocol.

Each fragrance was tested against each species of cockroach, with one species of cockroach used per test.

The test surface was vinyl flooring of 600mm x 600mm total area which was divided into an arena of nine equally sized channels each of 30mm x 600mm, as illustrated in Figure 1. 3.0ml of

a polish was applied by syringe to the test surface and the polish distributed evenly with an applicator such that half of the total test surface area (300mm x 600mm) was treated with the polish, as represented by the spotted area in Figure 1, and half the total test surface area was untreated. The polish was left to dry for approximately one hour. Five cockroaches, *periplaneta americana* or *blattella germanica*, of mixed age and gender were placed in each channel and their behaviour monitored by video recorder. The video recording commenced 10 minutes after introduction of the cockroaches to the channels and was stopped after 1 hour of recording. The cockroaches were then removed. After 24 hours, five cockroaches were returned to each of the channels and the recording process repeated. The video recording was played back and stopped at five minute intervals over an hour to obtain twelve readings. At each five minute interval, the number of cockroaches on the treated area was counted. The repellency for the nine channels was calculated as follows:

Total number of cockroach observations possible = 540 (12 times, 9 channels, 5 insects per channel)

Total number of cockroach observations on treated area if no effect = $540/2 = 270$

Total number of cockroaches observed on treated area = N (total of 12 times for 9 channels)

Therefore, Repellency (%) = $(270-N)/270 \times 100$

The results are as indicated in the table below with the number representing the percentage of cockroaches of a particular species repelled from the treated area.

Fragrance		t = 1 hour	t = 24 hours
1	<i>periplaneta americana</i>	88	63
	<i>blattella germanica</i>	94	52
2	<i>periplaneta americana</i>	71	69
	<i>blattella germanica</i>	64	68
3	<i>periplaneta americana</i>	84	69
	<i>blattella germanica</i>	79	86
4	<i>periplaneta americana</i>	85	74
	<i>blattella germanica</i>	72	85
5	<i>periplaneta americana</i>	94	87

(comparative)	<i>blattella germanica</i>	57	61
6	<i>periplaneta americana</i>	97	78
(comparative)	<i>blattella germanica</i>	32	58
7	<i>periplaneta americana</i>	81	-15
(comparative)	<i>blattella germanica</i>	59	2

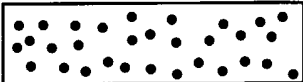
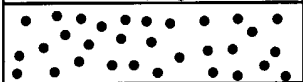
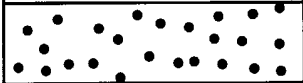
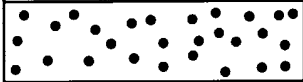
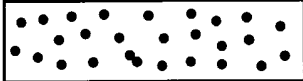
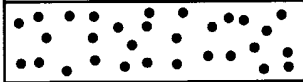
The results show that only Fragrances 1, 2, 3 and 4 repel at least 60% of both species of cockroach (i.e. *periplaneta americana* and *blattella germanica*) initially. Whilst comparative fragrances 5 and 6 demonstrate effective repellency to cockroaches of the species *periplaneta americana*, they demonstrate poorer repellency to the *blattella germanica* species. Comparative fragrance 7 does not demonstrate effective repellency against either species of cockroach after 24 hours.

CLAIMS

1. An insect repellent fragrance comprising;
 - (a) at least 10% by weight of the insect repellent fragrance of geraniol;
 - (b) at least 10% by weight of the insect repellent fragrance of diethyl phthalate; and
 - (c) at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate;wherein the insect repellent fragrance comprises at least 60% by total weight of the insect repellent fragrance of (a), (b) and (c).
2. An insect repellent fragrance according to claim 1, wherein the fragrance comprises at least two of linalol, limonene, citronellal, terpinolene, and p-tertiary butyl cyclohexyl acetate.
3. An insect repellent fragrance according to claim 1 or 2, wherein the fragrance comprises at least three of linalol, limonene, citronellal, terpinolene, and p-tertiary butyl cyclohexyl acetate.
4. An insect repellent fragrance according to any one of the preceding claims, wherein the fragrance comprises at least 1% by weight of the insect repellent fragrance of linalol.
5. An insect repellent fragrance according to any one of the preceding claims, wherein the fragrance comprises at least 2% by weight of the insect repellent fragrance of limonene.
6. An insect repellent fragrance according to any one of the preceding claims, wherein the fragrance comprises at least 2% by weight of the insect repellent fragrance of citronellal.

7. An insect repellent fragrance according to any one of the preceding claims, wherein the fragrance comprises at least 2% by weight of the insect repellent fragrance of terpinolene.
8. An insect repellent fragrance according to any one of the preceding claims, wherein the fragrance comprises at least 3% by weight of the insect repellent fragrance of p-tertiary butyl cyclohexyl acetate.
9. A product comprising an insect repellent fragrance in accordance with any one of the preceding claims.
10. A product comprising an insect repellent fragrance, wherein the product comprises;
 - (a) at least 0.025% by weight of the product of geraniol;
 - (b) at least 0.025% by weight of the product of diethyl phthalate; and
 - (c) at least one or more of linalol, limonene, citronellal, terpinolene and p-tertiary butyl cyclohexyl acetate; andwherein the product comprises at least 0.15% by total weight of the product of (a), (b) and (c).
11. A product according to claim 9 or 10, wherein the product is a hard surface cleaner, polish or paste, particularly a floor polish.
12. A method of repelling insects from a surface comprising the step of applying to the surface an effective amount of an insect repellent fragrance in accordance with any one of claims 1 to 8.
13. Use of an insect repellent fragrance in accordance with any one of claims 1 to 8 for repelling cockroaches, particularly German cockroaches (*blattella germanica*) and/or American cockroaches (*periplaneta americana*).

Fig.1.

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 A01N37/10 A01N31/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

CHEM ABS Data, WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00 27197 A (PROCTER & GAMBLE) 18 May 2000 (2000-05-18) page 4, line 1 -page 9, line 24 examples III,VIII,IX ---	1-12
Y	EP 0 619 363 A (COLGATE-PALMOLIVE COMPANY)) 12 October 1994 (1994-10-12) the whole document ---	1-13
Y	DATABASE WPI Derwent Publications Ltd., London, GB; AN 1990-118678 XP002212228 IWASE COSFA: "Insect repellent resin mouldings -contains inorganic porous microcapsules enclosing repellent core" abstract & JP 02 067202 A 7 March 1990 (1990-03-07) --- -/--	1-13



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

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L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

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