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(54) Title: REPELLENT FORMULATION

(57) Abstract: A formulation suitable for repelling Insecta and/or Arhynchobdellida comprises an inert carrier and, as active ingredients, each of the extracts from the plant species *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus*, *Juniperus* and *Eugenia*. The formulation is surprisingly effective for repelling both highland and lowland midges.

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Repellent Formulation

The present invention relates to a repellent formulation. In particular, the present invention relates to a formulation comprising natural ingredients, such as plant extracts,
5 which is effective for repelling insects.

Insect repellent formulations generally comprise one or more volatilizable components which, after application e.g. to the surface of the skin of a person, serve to dissuade insects, such as flying insects e.g. midges and mosquitoes, from entering or staying
10 within a region of air adjacent to the skin in which the volatilized components exist. Insect repellent formulations tend to comprise a plurality of volatilizable components, thereby rendering the formulation more effective against a broader range of insects than a formulation comprising a single volatilizable component.

15 Typically an insect repellent formulation comprises a liquid or solid carrier material for the volatilizable components. The carrier enables more efficient transport and distribution, such as by spreading on the surface of the skin of a person, of the volatilizable components. The carrier material may also serve to depress or elevate the vapour pressure of one or more of the volatilizable components, so as to increase or
20 moderate volatilization of those components.

Thus, the provision of an insect repellent formulation which is effective against a broad range of insects tends to require the optimisation of blends of volatilizable components.

25 Some insect repellent formulations advantageously employ volatilizable components which demonstrate synergistic effects in their repellent properties. These effects are rarely predictable, especially in multi-component formulations and formulations where other factors need to be taken into account, such as acceptability for topical application, olfactory response of a human user, colour and stability, among other factors.

30

In addition to an insect repellent formulation being non-toxic and non-irritating to humans, a further requirement of an insect repellent is environmental acceptability. An

insect repellent formulation which may be effective against a wide variety of insects but which could cause environment-changing pollution when released into the sea, such as when scores or hundreds of people wearing repellent are bathing on a popular beach, or into rivers or streams with delicate ecosystems is not environmentally safe. To ensure
5 environmental acceptability, insect repellent formulations these days preferably comprise only natural ingredients, such as plant extracts, which may be provided in the form of essential oils.

10 Insect repellent formulations comprising naturally occurring insect repelling components are well known.

US 2005/0249768 discloses an insect repellent composition containing citronella oil, D-limonene, 2 or more synergists, and 3 or more essential oils as the active ingredients. The preferred essential oils are geranium oil, rosemary oil and peppermint oil. In the
15 preferred embodiment, the synergists are aldehyde C-14 and aldehyde C-18. Vanillin is used as a stabilizer, and fragrances, fragrance enhancers and surfactants may be utilized. US2005/0112164 discloses an insect repellent comprised of all-natural ingredients to be applied directly to human skin, articles of clothing, and pets. The repellent action is attributable to a blend of essential oils of lemongrass, peppermint, thyme, geranium, and
20 rosemary. The essential oils are blended into a carrier comprised of soybean oil and wheat germ oil. The resulting blend is disclosed as being effective against flying insects and arthropods, as well as being non-toxic and environmentally safe.

US2003/0194454 discloses pesticidal compositions containing rosemary oil and/or
25 wintergreen oil. The compositions are described to have a broad spectrum of activity and are particularly effective against insects having a cuticle or proteinaceous exoskeleton. In paragraph [0060], there is disclosed a pesticidal composition comprising rosemary oil, wintergreen oil and, *inter alia*, one or more additional essential oil compounds and derivatives thereof, wherein a large, unlimited list of possible additional
30 essential oils is also provided. In paragraph [0063], the inventors speculate the essential oils attack a pest's nervous system or may act as Phase I and/or Phase II drug metabolizing enzyme inhibitors. Alternatively, it is suggested that the pesticidal

compositions may act via an alternative mode of action, as agonists or antagonists against the nerve receptor systems that are distinct to invertebrates. Though a large, unlimited list of such potential target pests is provided, midges are not disclosed.

US2003/0108582 discloses a composition that has insect repellent properties made from essential volatile oils. The composition includes a combination of menthol, eucalyptus oil, citronella oil and/or tea tree oil, alcohol, water and skin moisturizing components. The carrier is isopropyl alcohol, grain alcohol or other distilled alcohol. The water is deionized, distilled or any other type of sterile water. Skin conditioning oils may be included such as mineral oil, jojoba oil, glycerin, Vitamin E.

WO2004/010783 discloses DEET-free insect repellent compositions, based on essential oils, which are described to be effective against mosquitoes, flies, sandflies, leeches, fleas and ticks.

WO2004/036998 discloses a natural and non-toxic insect repellent composition which comprises a mixture of essential oils, including lime oil, myrtle, citronella oil and neem oil in a carrier oil.

EP 0433132 discloses a cosmetic composition for topical application, containing essential oils comprising, in a continuous aqueous phase for dispersion, ionic or nonionic amphiphilic lipid vesicles stabilising a dispersion of droplets of essential oils. In the composition, the essential oil is present in a proportion of 0.1 to 16% by weight relative to the total weight of the composition, and the weight ratio of the lipid phase to the essential oil is between 0.2 and 4. The essential oils employed in particular have an antibacterial and/or antifungal activity, in particular an activity against the Gram-positive bacteria for the preparation of deodorant or an insect-repellent activity.

US 5885600 discloses a composition that has insect repellent properties made from cold processed extracted oils and an antioxidant, particularly from a combination of Neem, Citronella and Cedarwood oils. The composition can be made into lotions, creams or sprays for application to mammals and vegetation, or it can be formed into polymeric sheets, which in turn can be formed into various useful articles, such as animal collars,

garbage bags, or planting material. The polymeric sheets can also be woven into cloth to form clothing, tents and other items.

There are many other publications disclosing the use of essential oils in pesticidal
5 and/or repellent compositions, including US2006/0135645, US2005/0233930,
US2002/0160035, US2003/0026823, US6300324, WO2000/64265, WO2000/00213 and
GB633676.

FR2576212 describes a composition comprising plant extracts from the species *Mentha*,
10 *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus* and *Juniperus*, which is disclosed
for use as a slimming aid.

In recent years, safety concerns have been expressed for the use of certain essential oils,
such as citronella, lemongrass and wintergreen oils, in products for application to
15 human skin. Thus, there is a continuing need for new environmentally acceptable, broad
spectrum insect repellent formulations which are suitable for application to human skin
and which do not contain citronella, lemongrass or wintergreen oils.

There is a continuing need for a new environmentally acceptable insect repellent
20 formulation which may be effective against a broader range of flying and/or biting
insects such as midges, mosquitoes and ticks, etc, or may be more effective against a
broad range of such flying and/or biting insects, than presently available formulations.
For example, a formulation which is highly effective at repelling both highland and
lowland Scottish midges (*Culicoides impunctatus* and *Culicoides obsoletus*), as well as
25 being effective against a broad spectrum of other flying and/or biting insects would be
highly desirable, as would be such a broad range repellent which does not require
frequent application or which is not easily washed off. Further, to avoid any of the
current safety concerns, the previously recited objectives should be achieved without
the use of citronella, lemongrass and wintergreen oils.

30

Insect repellent formulations are typically used in environments where a number of
other pest species or aggravating factors may be present. It is therefore advantageous if

an insect repellent composition also provides an active response to these other factors. Repellency for other species such as leeches is a particularly significant problem in swamp or everglade environments. Like insects, leeches, i.e. animals of the order Arhynchobdellida, are resisted by the provision of protective clothing. However, the use of heavy or closely woven clothing, such as disclosed in JP9111516, can be undesirable in tropical climates and a repellent composition would be much more convenient. Preferably, a broad spectrum insect repellent formulation which is highly effective at repelling both highland and lowland midges and leeches would be very desirable.

It is an object of the present invention to provide a further insect repellent formulation having environmental acceptability, such as provided by a 100% naturally derived composition, e.g. a composition derived entirely from plant extracts, and which demonstrates effectiveness against a broad range of insects, including both highland and lowland midges. Further, to avoid any of the current safety concerns, the formulation should not contain citronella, lemongrass and wintergreen oils.

It is also an object of the invention to provide a highland and lowland midge repellent formulation having one or more of the properties selected from high concentration effectiveness of active components, topical acceptability, broad spectrum insect repellency, longevity of effectiveness, biodegradability and anti-allergenecity.

Preferably, the present invention will provide a composition having effective repelling characteristics against both highland and lowland midges, against a broad range of other insects, including ticks and ants, and against leeches (Arhynchobdellida).

The present invention, in its various aspects, is as set out in the accompanying claims.

In one aspect, the present invention provides a formulation comprising an inert carrier and, as active ingredients, extracts from each of the plant species *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus* and *Juniperus*, characterised in that the formulation further comprises an extract from the plant species *Eugenia*. The formulation of the present invention is suitable for repelling a broad spectrum of insects,

including both highland and lowland midges. The formulation has also been found to be suitable for repelling Arhynchobdellida.

In another aspect, the present invention provides a method of repelling a broad spectrum of insects from a substrate e.g. the skin or hair of a human or other mammal, wherein said method comprising applying to said substrate a coating of a formulation comprising an inert carrier and, as active ingredients, extracts from each of the plant species *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus* and *Juniperus*, characterised in that the formulation further comprises an extract from the plant species *Eugenia*. Once applied to the substrates, the formulation has been found to repel a broad spectrum of insects including, surprisingly, both highland and lowland midges. The formulation has also been found to be suitable for repelling Arhynchobdellida.

In another aspect, the present invention provides the use of extracts from each of the plant species *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus*, *Juniperus* and *Eugenia* in the preparation of a formulation for repelling Insecta and/or Arhynchobdellida. When used together in a formulation comprising an inert carrier, the eight extracts have been found particularly effective for repelling both highland and lowland midges, as well as a broad spectrum of other insects.

The above extracts from the plant species are preferably, but independently selected from extracts of the plant species *Mentha Arvensis*, *Eucalyptus Globulus*, *Citrus Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus Vulgaris*, *Juniperus Virginiana* and *Eugenia Carophyllata*. Hence the *Mentha* species may be *Mentha Arvensis*, *Eucalyptus* species may be *Eucalyptus Globulus*, the *Citrus* species may be *Citrus Limonum*, the *Lavendula* species may be *Lavendula Officinalis*, the *Rosemarinus* species may be *Rosemarinus Officinalis*, the *Thymus* species may be *Thymus Vulgaris*, the *Juniperus* species may be *Juniperus Virginiana* and the *Eugenia* species may be *Eugenia Carophyllata*.

Preferably, the plant extracts are in the form of essential oils, and the formulation preferably comprises a blend of these essential oils in the presence of a carrier.

Preferably the carrier is non-aqueous, and is more preferably a naturally occurring plant extract, such as a naturally occurring oil e.g. grape seed oil (*Vitis Vinifera*), though in some applications aqueous or other carriers may be employed.

5

In one preferred embodiment, there is provided an Insecta and/or Arhynchobdellida repellent formulation comprising an inert carrier, e.g. grape oil, and, as active ingredients, essential oils from each of the plant species *Mentha Arvensis*, *Eucalyptus Globulus*, *Citrus Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus*
10 *Vulgaris*, *Juniperus Virginiana* and *Eugenia Carophyllata*. Preferably, the essential oils are extracted from the leaves or flowers of the recited plants or from the skins of the fruits of such plants. Preferably, the repellent formulation comprises essential oils from the leaves or flowers of each of *Mentha Arvensis*, *Eucalyptus Globulus*, *Citrus*
15 *Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus Vulgaris*, *Juniperus*
Virginiana and *Eugenia Carophyllata*.

The formulations of the present invention may additionally comprise further extracts from one or more plants, such as those extracts of *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis*. Preferably, the formulation of the present
20 invention comprises essential oil extracts from the leaves or flowers of each of *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis*. These further extracts may be present in the formulation in substantially equivalent amounts, i.e. they are present in the formulation in amounts differing by no more than 10% by weight of each other.
Formulations comprising further extracts of *Pinus*, *Melaleuca* and *Juniperus*, as well as
25 acting to repel insects and leeches, may also be useful as pesticides, such as insecticides.

We have found that formulations of the present invention are particularly effective against both highland and lowland Scottish midges, against Welsh heath and moorland
30 ticks, against Moroccan blue bottles and house flies, against Costa Rican sand flies, against Ecuadorian rainforest sweat bees and against mosquitoes in all these countries.
We have also found that the formulation is effective against leeches in the Ecuadorian

rainforest swamps and in Indonesian mangrove swamps and river delta areas, as well as being effective against flying insects in those areas.

The formulations of the present invention appear environmentally acceptable. In this
5 regard, it has been observed that the formulations are not repellent to leather back turtles.

As used herein, the term "repellent formulation" refers to a composition which reduces or eliminates voluntary contact of an animal species with a surface on which the
10 composition is present in comparison to a surface on which the composition is absent. That surface may be the skin or hair of a human being or other animal, and repellency typically occurs in an air space or liquid media adjacent to the surface where some component parts of the composition are present in vapour form or in solution or dispersion form, respectively. The repellent formulation may be absorbed into the
15 surface, such as into upper dermal layers of the skin, providing repellency beyond that of a vapour. The surface may also be of an inanimate object, such as an article formed of cloth or other fabric material, e.g. clothing, bedding and netting.

As used herein, the term Arhynchobdellida relates to species of leeches, such as those
20 leeches found in swamp, marsh and everglade environments.

The repellent formulation comprises an inert carrier. The carrier may be a solid or a liquid, and is preferably a non-aqueous liquid. The carrier assists efficient transport and distribution of the active ingredients, such as by spreading on the surface of the skin of a
25 person. The carrier material may also serve to depress or elevate the vapour pressure of one or more of the other components in the formulation, so as to increase or moderate volatilization of those other components. In one particular embodiment, a preferred carrier is an inert natural oil, such as the oil extract of *Vitis Vinifera*, more specifically grape seed oil. Other embodiments are envisaged wherein the inert carrier is a shampoo
30 base, a shower gel base, a sun screen base, a talcum powder base, and the like. The inert carrier may be alcohol based. The amount of carrier employed in the formulation will depend upon the desired physical form and the nature and amounts of the active

ingredients in the formulation. For example, the inert carrier in a liquid formulation may constitute at least 90 wt %, more preferably at least 95 wt%, most preferably at least 97 wt%, of the repellent formulation. The term "inert" as used herein means that the carrier per se contributes no effective repellency properties against insects.

5

The maximum amounts of active ingredients present in the repellent formulations of the present invention will depend upon the toxicity and irritant levels of the particular active ingredients employed. Typically, however, the total amount of active ingredients in a liquid formulation will be no more than 10 wt%, more preferably no more than 5 wt%,
10 most preferably no more than 3 wt%, of the repellent formulation. The individual active ingredients in a liquid formulation are preferably present at a concentration of from 0.001 to 4% by weight, preferably from 0.05 to 0.3% by weight, most preferably from 0.05 to 0.25% by weight. More preferably, the *Eugenia* extract is present in the formulation at a concentration of from 0.005 to 2% by weight when used in
15 combination with a liquid carrier, preferably from 0.05 to 0.2% by weight, most preferably from 0.05 to 0.15% by weight, and the extracts of *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*, *Rosemarinus*, *Thymus* and *Juniperus* are each present in the formulation in an amount of from 0.01 to 4% by weight, preferably from 0.05 to 0.3% by weight, most preferably from 0.05 to 0.25% by weight, of the formulation.

20

Further appropriate active plant extracts may be employed in the formulation in any appropriate amount. For example, when used in combination with a liquid carrier, such as grapeseed oil, a further active plant extract e.g. one or more extracts selected from *Pinus*, *Melaleuca* and *Juniperus* may each be present at a concentration of from 0.0001
25 to 0.1% by weight, preferably from 0.0005 to 0.02% by weight, most preferably from 0.005 to 0.015% by weight.

The formulation of the present invention may be provided in any convenient form, such as a solid or liquid. A liquid is preferred. Suitable liquid forms include solutions,
30 suspensions, dispersions, creams, ointments, or gels. A homogenous liquid form is preferred. Further components, such as stabilizers, surfactants and fragrances, to

provide the formulation in the desired physical form will be chosen by the skilled person in line with known practice.

5 When the insect repellent formulation is a liquid, it is preferably applied to the surface of e.g. an individual in a conventional manner, such as by pouring, squirting, rolling or spraying the formulation onto the surface. The formulation can be spread over the surface in a conventional manner, such as by rubbing with a hand.

10 The insect repellent formulation may be applied to the surface to be protected from insects and leeches as required. To obtain maximum benefit from use of the formulation, the formulation can be applied to the skin of an individual several times a day over successive days for as long as the individual is exposed to the insect and leeches. During use, the formulation may be beneficially absorbed into the upper layer of the skin, thereby providing a longer lasting protection, as the formulation is readily
15 evaporated or washed off.

The present invention offers a number of surprising benefits. For example, whilst the formulations of the present invention repel a broad range of insects, as could perhaps be expected by using a mixture of known insect repelling plant extracts, the formulation
20 once applied is surprisingly highly effective for repelling both highland and lowland midges, a property not previously recognised or present with other commercial insect repellents. The formulation is also highly effective for repelling leeches. Further, the active ingredients in the formulation appear to provide synergy, as the formulation appears to repel highland and lowland midges more efficiently than when the
25 ingredients are used on their own or in mixtures which do not comprise the extract from *Eugenia Carophyllata*, such as is demonstrated in the worked examples with highland and lowland Scottish midges. Insect repellent preparations not containing all the recited essential 8 active ingredients of the formulation do not repel insects, particularly highland and lowland midges any where near as effectively. The formulations of the
30 present invention may also be used to repel ticks. The formulations can also be used for detaching recently attached ticks on humans, which suggests that the formulations may well be useful for detaching ticks from other mammals as well e.g. dogs.

The invention in its various embodiments shall now be further described by way of exemplification only:

- 5 Formulations of insect repellents can be prepared by blending the following ingredients in the recited amounts:

Formulation 1 (comparative)

	1	Mentha Arvensis	0.2%
10	2	Eucalyptus Globulus	0.2%
	3	Citrus Limonum	0.2%
	4	Lavendula Officinalis	0.2%
	5	Rosemarinus Officinalis	0.2%
	6	Thymus Vulgaris	0.2%
15	7	Juniperus Virginiana	0.2%
	Carrier:	Vitis Vinifera	98.60%

Formulation 2

	1	Mentha Arvensis	0.2%
20	2	Eucalyptus Globulus	0.2%
	3	Citrus Limonum	0.2%
	4	Lavendula Officinalis	0.2%
	5	Rosemarinus Officinalis	0.2%
	6	Thymus Vulgaris	0.2%
25	7	Juniperus Virginiana	0.2%
	8	Eugenia Carophyllata	0.1%
	Carrier:	Vitis Vinifera	98.50%

Formulation 3

	1	Mentha Arvensis	0.2%
	2	Eucalyptus Globulus	0.2%
5	3	Citrus Limonum	0.2%
	4	Lavendula Officinalis	0.2%
	5	Rosemarinus Officinalis	0.2%
	6	Thymus Vulgaris	0.2%
	7	Juniperus Virginiana	0.2%
10	8	Eugenia Carophyllata	0.1%
	9	Pinus Sylvestris	0.01%
	10	Melaleuca Alternifolia	0.01%
	11	Juniperus Communis	0.01%
	Carrier:	Vitis Vinifera	98.47%

15

Each active ingredient in the worked formulations is an essential oil extracted from the leaves of the recited plant species. All recited amounts are in wt %.

20 The following worked examples are provided by the inventor as anecdotal evidence of the efficacy of the formulations of the present invention:

Whilst travelling in a number of countries of the world, including in India and in the Amazon Basin of Ecuador, I have used a commercially available diethyltoluamide (DEET) containing insect repellent (Jungle FormulaTM). However, despite applying the repellent in the advised amount, even at a frequency of 6 to 8 times a day, I found that I was still being bitten by mosquitoes and other insects.

During one visit to the Equadorian rainforest of the Amazon Basin, as well using a commercially available DEET-based insect repellent, I experimented with various essential oils, which on their own were already known to have insect repellent properties, by mixing the essential oils together into a single formulation and applying the formulation to the exposed parts of my body. To my surprise, when testing

30

Formulation 1 whilst working in swamps for three days, wet to my chest, along with many other workers, I noticed that at the end of each day's work, I was free of leeches, whereas the other workers had many leeches attached to their legs and chests. I did not experience freedom from leeches, however, when using Jungle FormulaTM. I also
5 noticed that, whilst working at temperatures of about 40 °C and 80% humidity in the Ecuadorian rainforest, after having previously applied Formulation 1 to all exposed areas of my skin, though my T shirt became sweat soaked and shortly afterwards it was covered in sweat bees (black bees that seek to eat the salt on sweaty animals or people), none of the bees landed on my exposed skin. In contrast, other workers with no similar
10 protection were completely covered in sweat bees. Also, at other times when I used Jungle FormulaTM, the bees still landed on my skin.

I also tested Formulation 1 whilst walking in heather and moorland in Wales. Whilst I passed through areas of heather and moorland which were highly infested with ticks, I
15 discovered that no ticks had attached on to my exposed legs or indeed found any crawling on my legs ready to bite. This surprised me as many times in the past whilst walking through the same heather and moorland area in Wales under very similar conditions but using various commercially available insect repellents, including Jungle FormulaTM, and I found them to be inadequate in stopping these ticks from attaching to
20 me. I also noticed that, when I used a commercially available repellent, ticks which had attached themselves to my legs, despite the use of the repellent, were readily detached when I applied Formulation 1 to them.

When I tested Formulation 1 in both the lowlands and highlands of Scotland, I noticed
25 that, whilst I received very few mosquito bites, I was still being bitten by midges: Formulation 1 did not appear to provide me with fully effective protection against the midges. When, however, I tested Formulation 2 in the lowlands and highlands, I noticed surprisingly that the midges were being effectively repelled by the Formulation.

30 Whilst working in Indonesia, I tested Formulation 1 and Formulation 2 against various other commercially available insect repellents, including Jungle FormulaTM and Mosi-GuardTM. I applied the commercial repellents as instructed 6 to 8 times a day.

Formulation 1 and Formulation 2 were applied only three times a day. None of the commercially available insect repellents performed as effectively as Formulation 1, as I found that I was bitten by mosquitoes more often whilst using the commercially available insect repellent than whilst using Formulation 1. I also noticed that I was
5 bitten much less frequently when using Formulation 2 than when using Formulation 1.

When tested in Sri Lanka against a number of commercially available insect repellent products, including a neem-based product, Formulation 2 was found be the preferred repellent as it appeared to perform the best.

10

I tested Formulation 2 and Formulation 3 in Scotland against both Highland and Lowland midges. The tests were performed during the period June until September, which period is considered to be the hight of the midge season. Dressed only in a pair of shorts and a T-shirt and using either Formulation 2 or Formulation 3 as a repellent, I sat
15 comfortably outside my tent in the Mabie Forest at dusk without being bitten at all (both formulations protected me from bites, but I also noticed that dead midges were on my legs when I used Formulation 3). In contrast, I observed that groups of people who were also on the camp site were being bitten and some even had to cover themselves up to avoid the midge bites, this being despite them using other insect repellents.

20

I also tested Formulation 2 and Formulation 3 whilst cycling along a hill side in the Highlands. Again, I received no midge bites when I used either formulation and I observed that a number of midges adhered to my legs were dead when I used Formulation 3.

25

For comparative purposes, I tested the effectiveness against midges of Formulation 3 and a formulation which was made up from 2% by wt *Eugenia Carophyllata* and 98% by wt *Vitis Vinifera* (hereafter Formulation 4) – this is considered to be an appropriate comparison to test the efficacy of the *Eugenia Carophyllata* in the formulations of the
30 present invention, as previous tests indicate *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis* have little effect against midges. Wearing a pair of shorts, I coated one leg in Formulation 3 and the other leg in an equal amount of Formulation 4, and

then went out for a strenuous period of exercise on a mountain bike, to ensure that I would provide a good midge target. When I stopped and inspected my legs, I noticed that the leg which was coated in Formulation 3 had not been bitten at all and that a number of dead midges were adhered to my leg. I also observed that some flying
5 midges appeared to deviate away from my leg. In contrast, I noticed that the leg coated in Formulation 4 had been bitten several times and that some midges were landing-on and then flying-off my leg as they were searching for areas to bite. As extracts of *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis* alone or together in Formulation 1 provide little or no effective repellency to midges, I conclude from my
10 experiments that it is the addition of the *Eugenia Carophyllata* in Formulation 1 that provides the effective repellency against highland and lowland midges of Formulation 2 and Formulation 3. Further, the presence of the *Eugenia Caraphyllata* together with the *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis* in Formulation 3 appears to provide a formulation which not only repels highland and lowland midges
15 but is lethal to them as well.

Whilst in Algeria in January, in Hassi Mouina, where there were many blue bottles and house flies flying around the street cafes, I found that Formulation 3 repelled the flies from landing on exposed areas of my skin and hair, thus lessening their irritation value.
20 Further, I observed that wiping Formulation 3 over hard surfaces close to ant entry points in my living accomodation provided an effective ant repellent (I made similar observations when tackling ants in my accommodation when staying in Spain and Switzerland).

25 I tested Formulation 3 in a mangrove swamp and river delta area in Indonesia. I found the formulation highly effective against insects and leeches.

In North Wales, I compared the perfomance of a market leading DEET-based insect repellent, EurekaTM midge repellent, and Formulation 3. Tests were performed around
30 dusk, as this is the best time to get the most savage attcks of midges, by sitting in a pair of shorts and a T-shirt for about an hour. Tests were performed on three similar evenings, weather wise and midge concentration wise. I found Formulation 3 was the

most effective repellent, in that I did not receive a single midge bite. In comparison, I received midge bites whilst wearing both the commercially available repellents, though EurekaTM performed better than the DEET-based product.

- 5 I also tested Formulation 3 against EurekaTM in Costa Rica in 2005, and found that Formulation 3 was more effective against sand flies and mosquito's than EurekaTM. The wearing of Formulation 3 when observing leather back turtles did not appear to affect the turtles on their approach and during their egg laying and nesting process.
- 10 The above examples demonstrate the effectiveness of the formulations of the invention in repelling insects and leeches. The examples further suggest that Formulation 3 may also be an effective insecticide.

Claims

1. A formulation comprising an inert carrier and at least the following active ingredients: plant extracts from the species *Mentha*, *Eucalyptus*, *Citrus*, *Lavendula*,
5 *Rosemarinus*, *Thymus* and *Juniperus*, characterised in that the formulation further comprises an extract from the plant species *Eugenia*.
2. A formulation as claimed in claim 1, wherein the active ingredients are selected from the group comprising plant extracts from the species: *Mentha Arvensis*,
10 *Eucalyptus Globulus*, *Citrus Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus Vulgaris*, *Juniperus Virginiana* and *Eugenia Carophyllata*.
3. A formulation as claimed in claim 2, wherein the formulation comprises plant extracts from each of the species *Mentha Arvensis*, *Eucalyptus Globulus*, *Citrus*
15 *Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus Vulgaris*, *Juniperus Virginiana* and *Eugenia Carophyllata* and further optionally comprises one or more plant extracts from the species *Pinus Sylvestris*, *Melaleuca Alternifolia* and *Juniperus Communis*.
- 20 4. A formulation as claimed in any one of the preceding claims, wherein the plant extracts are essential oils.
5. A formulation as claimed in claim 4, wherein the essential oils are extracts from the leaves or flowers of the plants or from the skins of the fruit of such plants.
25
6. A formulation as claimed in claim 4 or claim 5, wherein the formulation comprises a blend of essential oils from each of the species *Mentha Arvensis*, *Eucalyptus Globulus*, *Citrus Limonum*, *Lavendula Officinalis*, *Rosemarinus Officinalis*, *Thymus Vulgaris*, *Juniperus Virginiana*, *Eugenia Carophyllata*, *Pinus Sylvestris*,
30 *Melaleuca Alternifolia* and *Juniperus Communis*.

7. A formulation as claimed in any one of the preceding claims, wherein the carrier is a naturally occurring plant oil.
8. A formulation as claimed in claim 7, wherein the carrier is grapeseed oil
9. A formulation as claimed in claim 7 or claim 8, wherein the inert carrier is a plant oil present in the formulation in an amount of at least 90 wt % based on the weight of the formulation.
10. A formulation as claimed in any one of claims 7 to 9, wherein the total amount of active ingredients in a liquid formulation is no more than 10 wt % based on the weight of the formulation.
11. A formulation as claimed in any one of claims 7 to 10, wherein the individual active ingredients in the formulation are present at a concentration of from 0.0001 to 4 wt % based on the weight of the formulation.
12. A formulation as claimed in claim 1, comprising as active ingredients the essential oils of the plant species recited below in the recited amounts:
- | | |
|-------------------------|----------------------|
| Mentha Arvensis | 0.05 to 0.4 wt % |
| Eucalyptus Globulus | 0.05 to 0.4 wt % |
| Citrus Limonum | 0.05 to 0.4 wt % |
| Lavendula Officinalis | 0.05 to 0.4 wt % |
| Rosemarinus Officinalis | 0.05 to 0.4 wt % |
| Thymus Vulgaris | 0.05 to 0.4 wt % |
| Juniperus Virginiana | 0.05 to 0.4 wt % and |
| Eugenia Carophyllata | 0.05 to 0.4 wt %. |

13. A formulation as claimed in claim 12, wherein the formulation further comprises essential oils of the following recited active ingredients in the recited amounts:

Pinus Sylvestris	0.01 to 0.4 wt %
Melaleuca Alternifolia	0.001 to 0.4 wt % and
5 Juniperus Communis	0.001 to 0.4 wt %.

14. A formulation as claimed in claim 11 or 12, wherein the balance to 100% is grapeseed oil.

10 15. A method of repelling a broad spectrum of insects from a substrate, wherein said method comprising applying to said substrate a coating of a formulation as claimed in any one of the preceding claims.

15 16. A method as claimed in claim 15, wherein insects to be repelled include highland and lowland midges.

17. A method of repelling Arhynchobdellida from a substrate, wherein said method comprising applying to said substrate a coating of a formulation as claimed in any one of the preceding claims.

20 18. Use of extracts from each of the plant species Mentha, Eucalyptus, Citrus, Lavendula, Rosemarinus, Thymus, Juniperus and Eugenia in the preparation of a formulation for repelling Insecta and/or Arhynchobdellida.

25 19. An insect and/or leech repellent composition comprising the formulation claimed in any one of claims 1 to 14.

20. A pesticide composition comprising the formulation claimed in claims 3, 6 or 13.

30 21. Use of a formulation as claimed in any claims 3, claim 6 or claim 13 in or as a pesticide composition against highland and lowland midges.