

DESCRIPTION

INCENSE STICK AND METHOD FOR MANUFACTURING SAME

5 TECHNICAL FIELD

[0001] The present invention relates to an incense stick including a volatile chemical substance and a method for manufacturing the same.

BACKGROUND ART

10 [0002] So-called mosquito repellent coils have been known as an incense stick for repelling pests (see, for example, Patent Documents 1–5).

[0003] Patent Document 1 describes that an inorganic layer in which an insecticide such as a pyrethroid-based substance is mixed in an inorganic material such as clay is formed to have a thickness less than or equal to 1/3 of the thickness of a base layer, and the inorganic layer is
15 provided on a part or whole of the top, bottom, or side surface of the base layer.

[0004] Patent Documents 2–4 describe that a mixture of an ester compound expressed by a predetermined chemical formula and either an open-chain saturated hydrocarbon-based solvent or an alicyclic saturated hydrocarbon-based solvent is applied onto an incense stick base material.

20 [0005] Patent Document 5 describes that a liquid in which a liquid insecticide containing an insecticide substance includes a component hardly volatile at room temperature is produced, and a treated surface of an incense stick base material is treated with a liquid containing this component.

25 CITATION LIST

PATENT DOCUMENTS

[0006] Patent Document 1: Japanese Examined Patent Publication No. S46-28119

Patent Document 2: Japanese Patent Publication No. 2005-200403

Patent Document 3: Japanese Patent Publication No. 2005-298477

5 Patent Document 4: Japanese Patent Publication No. 2006-256991

Patent Document 5: Japanese Patent No. 4183790

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

10 [0007] In Patent Document 1 described above, layers of an insecticide are provided on top or bottom of the base layer, for example. In the case of an incense stick, however, since the insecticide is susceptible to heat generated during combustion of an incense stick base material and the heat might affect insecticide efficacy. Even in a case where layers of the insecticide are disposed as described in Patent Document 1, the degree of insecticidal efficacy
15 is not mentioned in Patent Document 1 and is still unclear.

[0008] In a case where an insecticide is applied onto an incense stick base material as described in Patent Documents 2–4, distribution of the insecticide in the depth direction of the incense stick base material is determined in accordance with results, and insecticidal efficacy might degrade under the influence of heat during combustion of the incense stick base
20 material.

[0009] Some incense sticks include perfumes as well as an insecticide. Such incense sticks are also required of obtaining sufficient effects with minimum perfumes contained.

[0010] The present invention has been made in view of the foregoing circumstances and has an object of enhancing efficacy obtained by a chemical substance included in an incense
25 stick.

SOLUTION TO THE PROBLEM

[0011] To achieve the object, according to the present invention, esters whose molecular weights are greater than or equal to a predetermined threshold are included.

[0012] In a first aspect, in an incense stick in which an incense stick base material includes
5 a volatile chemical substance, the incense stick includes a fatty ester having a molecular weight of 400 or more.

[0013] With this composition, since fatty ester having a molecular weight of 400 or more is included, the chemical substance can be easily vaporized during combustion of the incense stick, and an effective transpiration rate of the chemical substance can increase.

10 [0014] In a second aspect, the molecular weight of the fatty ester may be 500 or more.

[0015] With this composition, the effective transpiration rate of the chemical substance can further increase.

[0016] In a third aspect, the fatty ester may include at least one selected from the group consisting of stearic acid 3-isoamyl-6-methyl-2-heptyl, isostearic acid 2-hexyldecyl, and
15 trioleoyl glycerol.

[0017] That is, stearic acid 3-isoamyl-6-methyl-2-heptyl, isostearic acid 2-hexyldecyl, and trioleoyl glycerol are liquids at room temperature, and thus, workability in causing the incense stick base material to include these materials can be enhanced in the process of manufacturing the incense stick.

20 [0018] In a fourth aspect, the volatile chemical substance may be a pyrethroid-based compound.

[0019] With this composition, each of stearic acid 3-isoamyl-6-methyl-2-heptyl, isostearic acid 2-hexyldecyl, and trioleoyl glycerol is compatible to a pyrethroid-based compound. Thus, workability in mixing the fatty ester and the pyrethroid-based compound and then
25 causing the incense stick base material to include this mixture can be enhanced in the process

of manufacturing the incense stick.

[0020] In a fifth aspect, the fatty ester and the volatile chemical substance may be applied onto the incense stick base material.

[0021] With this composition, the volatile chemical substance can easily remain in an outer
5 layer portion of the incense stick base material, and thus, heat generated during combustion is less likely to adversely affect the chemical substance.

[0022] In a sixth aspect, a base material outer layer portion having a thickness that is 1/16 of a total thickness of the incense stick base material may include 30% or more of the volatile chemical substance included in the entire incense stick base material.

10 [0023] With this composition, 30% or more of the volatile chemical substance is locally present in the base material outer layer portion. The thickness of this base material outer layer portion is 1/16 of the total thickness of the incense stick base material, and is sufficiently small relative to the total thickness. Since 30% or more of the chemical substance is locally present in the base material outer layer portion whose thickness is 1/16 of
15 the total thickness, the volatile chemical substance can be easily vaporized from the base material outer layer portion during combustion, and thus, heat generated during combustion is less likely to adversely affect the volatile chemical substance. As a result, efficacy by the chemical substance can be enhanced.

[0024] In a seventh aspect, in a method for manufacturing an incense stick in which an
20 incense stick base material includes a volatile chemical substance, a fatty ester having a molecular weight of 400 or more and the volatile chemical substance were mixed and an impregnating undiluted solution is thereby obtained, and then the impregnating undiluted solution is applied onto the incense stick base material.

[0025] In an eighth aspect, the impregnating undiluted solution may include normal
25 paraffin as a solvent.

ADVANTAGES OF THE INVENTION

[0026] According to the present invention, since the fatty ester having a molecular weight of 400 or more is included, the effective transpiration rate of the chemical substance can be increased, and thus, efficacy by the chemical substance can be enhanced.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0027] [FIG. 1] A cross-sectional view of an incense stick according to an embodiment.

[FIG. 2] An illustration for describing a repellent test scheme.

10 DESCRIPTION OF EMBODIMENTS

[0028] An embodiment of the present invention will be described in detail with reference to the drawings. The following embodiment is merely an example in nature, and is not intended to limit the invention, applications, and use of the applications.

[0029] FIG. 1 illustrates a cross section of an incense stick 1 according to an embodiment
15 of the present invention. The cross section of FIG. 1 is a cross section taken in a direction orthogonal to a direction in which the incense stick 1 extends. The incense stick 1 may extend linearly or spirally, for example, and is not limited to a specific shape. The cross-sectional shape of the incense stick 1 may also have various shapes such as a rectangle, a circle, or an oval. In this embodiment, the shape of the incense stick 1 is a spiral shape, and
20 a cross-sectional shape thereof is close to a rectangle as illustrated in FIG. 1, and each of the four corners is close to an arc. Broken lines indicated by L1 and L2 in FIG. 1 are added only for convenience in describing distribution of a chemical substance described later, and are not actually added to the incense stick 1.

[0030] In the incense stick 1, an incense stick base material 2 includes a volatile chemical
25 substance and fatty ester having a predetermined molecular weight or more. Examples of

the volatile chemical substance include an insecticide (a pyrethroid-based compound) and various types of perfumes. Examples of the insecticide include dimefluthrin, transfluthrin, allethrin, dl,d-T80-allethrin, dl,d-T-allethrin, d,d-T-allethrin, prallethrin, metofluthrin, mepafluthrin, renofluthrin, empenthrin, pyrethrin, profluthrin, heptafluthrin, tetraflumethrin, phtalthrins, resmethrin, phenothrin, permethrin, cyphenothrin, and imiprothrin.

[0031] The fatty ester may have a molecular weight of 400 or more. The fatty ester may be of a type that is in a liquid state at room temperature. In the case of using a pyrethroid-based compound as the volatile chemical substance, a fatty ester that is compatible with the pyrethroid-based compound may be selected. Examples of fatty esters satisfying this condition include stearic acid 3-isoamyl-6-methyl-2-heptyl, isostearic acid 2-hexyldecyl, and trioleoyl glycerol. It is sufficient to include at least one of these fatty esters, and any two or more of these fatty esters may be included. In addition, a fatty ester having a molecular weight of 400 or more may be used.

[0032] Stearic acid 3-isoamyl-6-methyl-2-heptyl has a chemical formula of $C_{27}H_{54}O_2$, and has a molecular weight of 411. Isostearic acid 2-hexyldecyl has a chemical formula of $C_{34}H_{68}O_2$ and has a molecular weight of 509. Trioleoyl glycerol has a chemical formula of $C_{57}H_{104}O_6$ and has a molecular weight 885. Fatty esters to be selected preferably have molecular weights of 500 or more, and more preferably have molecular weights of 600 or more.

[0033] The incense stick base material 2 includes at least a flammable combustion material such as wood powder, paper, or pulp, and a binder for solidifying the combustion material, such as cornstarch. The incense stick base material 2 may include a colorant, for example.

[0034] The incense stick 1 is manufactured such that concentration distribution of the volatile chemical substance is not uniform in the depth direction of the incense stick base material 2. That is, 30% or more of the volatile chemical substance included in the entire

incense stick base material 2 is included in a base material outer layer portion 2a having a thickness T2 that is 1/16 of a total thickness T1 of the incense stick base material 2. The base material outer layer portion 2a is a portion between the outer surface of the incense stick base material 2 and the broken line L1, and is disposed over the entire front surface (top surface in FIG. 1), side surfaces, and back surface (lower surface in FIG. 1) of the incense stick base material 2. The broken line L1 specifies a thickness range that is 1/16 of the total thickness T1 of the incense stick base material 2, and a frame-shaped line whose shape is analogous to the cross-sectional shape of the incense stick base material 2. The base material outer layer portion 2a preferably includes 50% or more of the volatile chemical substance included in the entire incense stick base material 2, and more preferably includes 60% or more of the volatile chemical substance included in the entire incense stick base material 2. For example, in a case where the total thickness T1 of the incense stick base material 2 is 4 mm, the thickness T2 that is 1/16 of the total thickness T1 is 0.25 mm. Accordingly, the thickness of the base material outer layer portion 2a is 0.25 mm. In this case, a portion of the incense stick base material 2 except for the base material outer layer portion 2a is an inner layer portion, and this inner layer portion includes the remainder of the volatile chemical substance. The thickness T2 is preferably 0.3 mm or less, and more preferably 0.25 mm or less.

[0035] Alternatively, a base material outer layer portion 2b having a thickness T3 that is 1/8 of the total thickness T1 of the incense stick base material 2 may include 50% or more of the volatile chemical substance included in the entire incense stick base material 2. In this case, the base material outer layer portion 2b is a portion between the outer surface of the incense stick base material 2 and the broken line L2, and is disposed over the entire front surface, side surfaces, and back surface of the incense stick base material 2. The broken line L2 specifies a thickness range that is 1/8 of the total thickness T1 of the incense stick base

material 2, and a frame-shaped line whose shape is analogous to the cross-sectional shape of the incense stick base material 2, and is located inside the broken line L1. For example, in a case where the total thickness T1 of the incense stick base material 2 is 4 mm, the thickness T3 that is 1/8 of the total thickness T1 is 0.5 mm. Accordingly, the thickness of the base material outer layer portion 2b is 0.5 mm. In this case, a portion of the incense stick base material 2 except for the base material outer layer portion 2b is an inner layer portion, and this inner layer portion includes the remainder of the volatile chemical substance.

[0036] One of the front surface or the back surface of the incense stick base material 2 may be impregnated with the volatile chemical substance, or both of the front surface and the back surface of the incense stick base material 2 may be impregnated with the volatile chemical substance. The front surface, back surface, and side surfaces of the incense stick base material 2 may be impregnated with the volatile chemical substance.

[0037] (Method for Manufacturing Incense Stick 1)

A method for manufacturing the incense stick 1 having the composition described above will now be described. First, an incense stick base material 2 and an undiluted solution to be applied to the incense stick base material 2 (impregnating undiluted solution) are prepared. The impregnating undiluted solution includes the volatile chemical substance, the fatty ester, and a solvent. Examples of the solvent include normal paraffin such as parazol 134, hexane, ethanol, and water. Any one of these materials may be used solely or two or more of the materials may be used in combination. The amount of the volatile chemical substance may be, but is not limited to, about 3.75 mg for one incense stick 1, for example, and may be set at any amount in consideration of efficacy.

[0038] Thereafter, the impregnating undiluted solution is applied onto the previously prepared incense stick base material 2 such that 30% or more of the chemical substance included in the entire incense stick base material 2 is included in the base material outer layer

portion 2a having a thickness that is $1/16$ of the total thickness of the incense stick base material 2. This can be achieved depending on, for example, the degree of dilution of the chemical substances in accordance with the type and the amount of the solvent.

[0039] Alternatively, the impregnating undiluted solution may be applied onto the
5 previously prepared incense stick base material 2 such that 50% or more of the chemical substance included in the entire incense stick base material 2 is included in the base material outer layer portion 2b having a thickness that is $1/8$ of the total thickness of the incense stick base material 2. This can be also achieved depending on, for example, the degree of dilution of the chemical substances in accordance with the type and the amount of the solvent.

[0040] [Table 1]

Chemical substance content (mg)	Comparative Example 1	Application Method				
		Comparative Example 2	Comparative Example 3	Example 1	Example 2	Example 3
	kneading	n paraffin	butyl stearate	stearic acid 3-isoamyl-6-methyl-2-heptyl	isostearic acid 2-hexyldecyl	trioleoyl glycerol
			molecular weight of 341	molecular weight of 411	molecular weight of 509	molecular weight of 885
	0.47	1.19	1.08	1.17	1.28	1.59
	base material outer layer portion 2a					
base material outer layer portion 2b	0.94	1.71	1.8	1.92	1.87	2.68
inner layer portion	2.81	2.05	1.96	1.83	1.88	1.07
effective transpiration rate (%)	70	79	80	88	90	94
chemical substance: dimefluthrin 3.75mg						

[0041] The impregnating undiluted solution is obtained by mixing each fatty ester and a solvent at a ratio of 1:1, and a small amount of dimefluthrin (0.52%w/w) is added to the mixture.

[0042] Table 1 shows effective transpiration rates of Comparative Examples 1–3 and Examples 1–3. The “effective transpiration rate (%)” in Table 1 is a value indicating the amount of dimefluthrin (volatile chemical substance) included in the incense stick 1 that is vaporized with efficacy when the incense stick 1 is burnt. If the effective transpiration rate is 100%, all the dimefluthrin included in the incense stick 1 is vaporized with efficacy, whereas if the effective transpiration rate is 0%, all the dimefluthrin included in the incense stick 1 shows no efficacy. As a measurement method, all the gas generated by burning the incense stick 1 is collected and the amount of dimefluthrin is measured with measurement equipment such as a gas chromatography, for example. Then, the ratio of the amount of collected dimefluthrin to dimefluthrin included in a burnt portion of the incense stick 1 is obtained, and the obtained ratio can be used as an effective transpiration rate.

[0043] Comparative Example 1 is an incense stick obtained by a kneading method. The “kneading method” in Table 1 is a manufacturing method for obtaining an incense stick by kneading 3.75 mg of dimefluthrin as a volatile chemical substance in wood powder or a binder constituting the incense stick base material, and then solidifying these materials. The amount of wood powder in which 3.75 mg of dimefluthrin is kneaded corresponds to an amount for one general spiral incense stick 1. In the case of an incense stick obtained by this kneading method, the concentration of dimefluthrin is substantially uniform in the thickness direction. Accordingly, the inner layer portion includes an amount obtained by subtracting the amount of the chemical substance of the base material outer layer portion 2b from the total amount (3.75 mg). The amount of the chemical substance can be expressed by wt%.

[0044] Comparative Examples 2 and 3 and Examples 1–3 are impregnated incense sticks

obtained by coating the incense stick base material 2 with an impregnating undiluted solution. Comparative Example 2 is an impregnated incense stick obtained by dissolving 3.75 mg of dimefluthrin in n paraffin (normal paraffin) as a solvent to obtain an impregnating undiluted solution and then applying the impregnating undiluted solution onto the incense stick base material 2. The n paraffin may be, for example, parazol 134, and the same holds for the following examples. Comparative Example 3 is an impregnated incense stick obtained by dissolving 3.75 mg of dimefluthrin and butyl stearate in n paraffin as a solvent to obtain an impregnating undiluted solution and then applying the impregnating undiluted solution onto the incense stick base material 2. Butyl stearate has a chemical formula of $C_{22}H_{44}O_2$ and a molecular weight of 341.

[0045] Example 1 is an impregnated incense stick obtained by mixing 3.75 mg of dimefluthrin, stearic acid 3-isoamyl-6-methyl-2-heptyl, and n paraffin as a solvent to obtain an impregnating undiluted solution, and then applying the impregnating undiluted solution onto the incense stick base material 2.

[0046] Example 2 is an impregnated incense stick obtained by mixing 3.75 mg of dimefluthrin, isostearic acid 2-hexyldecyl, and n paraffin as a solvent to obtain an impregnating undiluted solution, and then applying the impregnating undiluted solution onto the incense stick base material 2.

[0047] Example 3 is an impregnated incense stick obtained by mixing 3.75 mg of dimefluthrin, trioleoyl glycerol, and n paraffin as a solvent to obtain an impregnating undiluted solution, and then applying the impregnating undiluted solution onto the incense stick base material 2.

[0048] The effective transpiration rate of the kneading method in Comparative Example 1 was 70%, the effective transpiration rate in the case of using n paraffin as a solvent in Comparative Example 2 was 79%, and the effective transpiration rate in the case of using n

paraffin as a solvent and including a fatty ester having a molecular weight less than 400 in Comparative Example 3 was 80%. On the other hand, the effective transpiration rates in the case of using n paraffin as a solvent and including a fatty ester having a molecular weight of 400 or more in Examples 1–3 were as high as 88%–94%. The solvent may be water, ethanol, or hexane. With any of these solvents, an effective transpiration rate higher than those in Comparative Examples 1–3 can be obtained as long as a fatty ester having a molecular weight of 400 or more is included.

[0049] Examples 1–3 in Table 1 show specific methods and results thereof in allowing the base material outer layer portion 2a to include 30% or more of the chemical substance included in the entire incense stick base material 2 or allowing the base material outer layer portion 2b to include 50% or more of the chemical substance included in the entire incense stick base material 2.

[0050] To obtain the amount of the volatile chemical substance included in the base material outer layer portion 2a or 2b, first, an amount corresponding to the thickness of the base material outer layer portion 2a or 2b is cut away with the thickness of the base material being measured with a caliper, and the amount of the chemical substance included in the cut-away portion is measured by gas chromatography. The amount of the chemical substance included in a portion except for the base material outer layer portion 2a or 2b (inner layer portion) is measured.

[0051] (Repellent Test)

Next, a repellent test will be described. A constant-temperature test chamber 100 is prepared as illustrated in FIG. 2. The size of the test chamber 100 corresponds to about eight tatami mats. The room temperature of the test chamber 100 is 28°C. The test chamber 100 is provided with two air intake windows 101 for taking air in the test chamber 100 and one air release window 102 for releasing air from the test chamber 100. For

ventilation of the test chamber 100, the amount of air inlet and the amount of air outlet were set such that the ventilation is performed ten times per one hour. The test sample is the incense stick 1. Test insects 104 were female adults of tropical house mosquitos (Jakarta D types), and 50 test insects 104 were prepared in a container. A lure source was a human 103.

5 The test method was a Free-Fly, 0-start, and human-lure method.

[0052] First, as illustrated in FIG. 2, test insects 104 were placed at a corner of the test chamber 100, and the incense stick 1 as a test sample was placed around the center of the test chamber 100 near the floor of the test chamber 100. A human 103 serving as a lure source is placed at a corner diagonally opposite to the corner of the test chamber 100 at which the test
10 insects 104 is placed.

[0053] Thereafter, the lid of the container including 50 test insects was gently opened concurrently with ignition of the incense stick 1, and the test insects were released into the test chamber 100. The number of blood sucking mosquitoes flying to the human in one hour from the release of the test insects was recorded with time (chamber blood sucking number).

15 Similarly, in an unillustrated test chamber without an incense stick (untreated chamber), 50 test insects were left so that the number of blood sucking mosquitoes flying to the human was recorded (untreated chamber blood sucking number). The blood sucking inhibition rate is calculated by:

[0054] Blood sucking inhibition rate (%) = $(C - T)/C \times 100$

20 C: untreated chamber blood sucking number

T: chamber blood sucking number

[0055] [Table 2]

	Comparative Example 1	Comparative Example 2	Example 2	Example 3
repellent rate (%)	53.2	57.2	61.8	62.5
efficacy ratio	100	108	116	118

[0056] The “repellent rate” in Table 2 represents the blood sucking inhibition rate. The “efficacy ratio” in Table 2 represents a relative ratio when a repellent efficacy of Comparative Example 1 is 100. As show in Table 2, the efficacy ratio is 100 in Comparative Example 1 and the efficacy ratio is 108 in Comparative Example 2, whereas the efficacy ratio is 116 in
5 Example 2 and the efficacy ratio in Example 3 is 118. Although not shown in Table 2, based on the results of Table 1, the efficacy ratio is also significantly high in Example 1.

[0057] (Advantages of Embodiment)

As described above, according to this embodiment, since the incense stick 1 in which the incense stick base material 2 includes the volatile chemical substance includes a
10 fatty ester having a molecular weight of 400 or more, the chemical substance is easily vaporized during combustion of the incense stick 1 so that the effective transpiration rate of the chemical substance increases and efficacy of the chemical substance can be enhanced.

[0058] In addition, although the volatile chemical substance is dimefluthrin in the embodiment, the volatile chemical substance may be, for example, a pyrethroid-based
15 compound such as transfluthrin or allethrin. In this case, similar advantages can also be obtained. In a case where the volatile chemical substance is perfume, efficacy of the perfume can be enhanced.

[0059] (Other Embodiments)

The embodiment described above is merely illustrative in every respect, and should
20 not be interpreted in a limited manner. Furthermore, variations and modifications within the scope of claims are all within the scope of the present invention.

[0060] The embodiment is intended to obtain the incense stick 1 according to the embodiment of the present invention by applying the impregnating undiluted solution onto the incense stick base material. The present invention, however, is not limited to this example,
25 and the incense stick 1 according to the embodiment of the present invention may be obtained

by kneading a fatty ester having a molecular weight of 400 or more and a volatile chemical substance in wood powder or a binder constituting an incense stick base material and then solidifying the mixture. In this case, the incense stick 1 including a fatty ester having a molecular weight of 400 or more can be obtained. Thus, advantages similar to the
5 impregnated incense stick can be obtained.

INDUSTRIAL APPLICABILITY

[0061] As described above, the present invention is applicable to an insecticidal incense stick and an aromatic incense stick, for example.

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DESCRIPTION OF REFERENCE CHARACTERS

[0062] 1 incense stick

2 incense stick base material

2a base material outer layer portion

15 2b base material outer layer portion

CLAIMS

1. An incense stick in which an incense stick base material includes a volatile chemical substance, the incense stick comprising
5 a fatty ester having a molecular weight of 400 or more.
2. The incense stick according to claim 1, wherein
the molecular weight of the fatty ester is 500 or more.
- 10 3. The incense stick according to claim 1, wherein
the fatty ester includes at least one selected from the group consisting of stearic acid
3-isoamyl-6-methyl-2-heptyl, isostearic acid 2-hexyldecyl, and trioleoyl glycerol.
4. The incense stick according to claim 3, wherein
15 the volatile chemical substance is a pyrethroid-based compound.
5. The incense stick according to claim 3, wherein
the fatty ester and the volatile chemical substance are applied onto the incense stick
base material.
20
6. The incense stick according to claim 1, wherein
a base material outer layer portion having a thickness that is 1/16 of a total
thickness of the incense stick base material includes 30% or more of the volatile chemical
substance included in the entire incense stick base material.

25

7. A method for manufacturing an incense stick in which an incense stick base material includes a volatile chemical substance, wherein

a fatty ester having a molecular weight of 400 or more and the volatile chemical substance were mixed and an impregnating undiluted solution is thereby obtained, and then
5 the impregnating undiluted solution is applied onto the incense stick base material.

8. The method for manufacturing an incense stick according to claim 7, wherein

the impregnating undiluted solution includes normal paraffin as a solvent.

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