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(54) Title: LIQUID SCHOENOCAULON EXTRACT

(57) Abstract: The present invention is directed to methods of producing liquid sabadilla extract. The invention also relates to methods for controlling pests by application of liquid sabadilla seed extract to pests' environment or to pests.

LIQUID SCHOENOCAULON EXTRACT

FIELD OF THE INVENTION

[0001] The present invention is directed to methods of producing a liquid sabadilla extract and methods of its use as a pesticide.

BACKGROUND OF THE INVENTION

[0002] Controlling damaging pests on plants grown to provide human food is a constant struggle for growers. Insects can completely destroy a harvest and can cause catastrophic food shortages or financial ruin for the growers. Although many products are effective against insects that damage plants, the products must also be safe enough to be released into the growing environment and safe enough to be applied to parts of the plants that will eventually be consumed.

[0003] Organic farming is increasing in popularity. Organic farming restricts the use of compounds that are used for pest control to encourage sustainability and safety. Insecticides can be used in organic farming if they are considered "natural." Unfortunately, many of the natural insecticides currently available are not potent enough to provide adequate insect control. Further, many of the currently available natural pesticides are not practical to apply or their application is cost prohibitive.

[0004] One effective naturally derived insecticide is found in the tissues of many of the plants of the genus *Schoenocaulon*. The species with the longest history of use, and the most readily available, is *Schoenocaulon officinale*. The plant is indigenous to Central and South America and its seeds have been used for centuries for their insecticidal properties. The seeds contain the alkaloids veratridine and cevadine, both of which are known to be active against arthropods.

[0005] Usually the dried seeds are ground to a powder and the powder is applied dry or wetted to the insects. The dust from the seeds, however, can cause eye and nasal irritation. Another disadvantage of using the ground seeds is that the alkaloids break down quickly in sunlight and do not provide any residual protection.

[0006] U.S. Patent Nos. 2,348,949 and 2,390,911 disclose the use of ground sabadilla seeds with beta-butoxy-beta-prime-thiocyanodiethyl-ether to control houseflies. Further, these patents teach heating the seeds and using them as a powder, or mixing them with kerosene to form a sprayable formulation. Neither of these disclosed mixtures of ground sabadilla seeds would be appropriate for organic farming.

[0007] Accordingly, there is a need for new methods of controlling insects. The methods should be potent, safe for growers to apply, safe to beneficial organisms (target specific), and safe for the environment.

SUMMARY OF THE INVENTION

[0008] In one aspect, the present invention is directed to methods for creating a liquid sabadilla extract.

[0009] In another aspect, the present invention is directed to liquid pesticidal sabadilla extract products produced by the process comprising the steps of milling sabadilla seeds or other plant parts, washing the milled sabadilla seeds or other plant parts with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives under agitation to dissolve the sabadilla oil, removing the extract solvent and sabadilla oil from the washed milled seeds or other plant parts, washing the de-oiled milled sabadilla seeds or other plant parts with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol under agitation to dissolve the sabadilla extract in the seed or plant part solvent, removing the seed or plant part solvent and sabadilla extract from the de-oiled washed milled seeds or other plant parts, adding propylene glycol to the sabadilla extract in the seed or plant part solvent, and removing the seed or plant part solvent from the sabadilla extract and propylene glycol to produce the liquid sabadilla extract.

[00010] In a further aspect, the present invention is directed to methods for controlling pests comprising applying a liquid sabadilla extract to pests or to their environment.

[00011] In a preferred embodiment, the liquid sabadilla extract is produced from sabadilla seeds.

DETAILED DESCRIPTION OF THE INVENTION

[00012] Applicant has unexpectedly developed new methods of producing a liquid sabadilla extract. While sabadilla extracts are desirable because they can concentrate the alkaloids, they can also be very difficult to handle and have a tar-like viscosity. Applicant unexpectedly developed a way to make the sabadilla extracts easy to handle, use and apply.

[00013] Applicant's methods involve de-oiling milled sabadilla seeds or other plant parts (by washing them with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives) and then removing the solid inert parts, such as the cellulose, hemicellulose, lignin and pectin, from the rest of the seed or other plant parts (with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol). Propylene glycol is then added to the remaining extract and the seed or plant part solvent is removed.

[00014] These methods produce a liquid that contains the alkaloids in a more concentrated form. The concentrated liquid sabadilla extract is more effective than the ground whole seeds or other plant parts because the parts of the seeds or other plant parts that do not contain alkaloids have been removed from the extract.

[00015] Further, the solid, inert parts of the seeds or other plant parts can no longer clog spray equipment. Yet another advantage of the liquid sabadilla extract is that it is easier to handle and can be poured or pumped to meet the needs of growers. Applicant's methods for production of the liquid sabadilla extract are also high yielding and can be easily scaled up for commercial use.

[00016] In addition, propylene glycol is Organic Materials Review Institute (OMRI) approved which means the liquid sabadilla extract can be used in organic farming.

[00017] In one embodiment, the present invention is directed to methods for producing a liquid sabadilla extract comprising milling sabadilla seeds or other plant parts, washing the milled sabadilla seeds or other plant parts with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives under agitation to dissolve the sabadilla oil, removing the extract solvent and

sabadilla oil from the washed milled seeds or other plant parts, washing the de-oiled milled sabadilla seeds or other plant parts with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol under agitation to dissolve the sabadilla extract in the seed or plant part solvent, removing the seed or plant part solvent and sabadilla extract from the de-oiled washed milled seeds or other plant parts, adding propylene glycol to the sabadilla extract in the seed or plant part solvent, and removing the seed or plant part solvent from the sabadilla extract and propylene glycol to produce the liquid sabadilla extract.

[00018] Sabadilla seeds and extract may be derived from any species of *Schoenocaulon*. The genus *Schoenocaulon* includes the following species: *Schoenocaulon calcicola, Schoenocaulon caricifolium, Schoenocaulon comatum, Schoenocaulon conzattii, Schoenocaulon dubium (alt. Schoenocaulon gracile), Schoenocaulon framei, Schoenocaulon ghiesbreghtii (alt. Schoenocaulon drummondii, Schoenocaulon yucatanense), Schoenocaulon ignigenum, Schoenocaulon intermedium, Schoenocaulon jaliscense, Schoenocaulon macrocarpum (alt. Schoenocaulon lauricola), Schoenocaulon madidorum, Schoenocaulon megarrhizum, Schoenocaulon mortonii, Schoenocaulon oaxacense, Schoenocaulon obtusum, Schoenocaulon officinale, Schoenocaulon pellucidum, Schoenocaulon plumosum, Schoenocaulon pringlei, Schoenocaulon rzedowskii, Schoenocaulon tenorioi, Schoenocaulon tenue, Schoenocaulon tenuifolium, Schoenocaulon texanum*, and *Schoenocaulon tigrense.*

[00019] In a preferred embodiment, the sabadilla seeds can be derived from *S. officinale*.

[00020] To optimize solvent penetration and subsequent extraction, the seed coat must be ruptured and the distance between penetrable surfaces of the seed reduced as much as possible. The can be achieved by milling the seeds.

[00021] Sabadilla seeds are very difficult to cleanly break into fine pieces. The bulk of the seed is hard and oily and requires a lot of energy to pulverize, producing heat due to high friction. Any suitable milling method can be used. Applicant found that cryogenic hammer milling the seeds was ideal for efficient extraction of the sabadilla oil.

[00022] Cryogenic grinding, or cryomilling, most commonly uses dry ice, liquid carbon dioxide or liquid nitrogen to cool the feed material in a mill of an otherwise conventional design (e.g. a cryogenic hammermill.) This super-cooling makes the sabadilla seed more uniformly

brittle, in turn making it easier to control particle size. Additionally, the oil in the seed is a solid at the temperature of liquid nitrogen, and does not slow processing speed. This increased friability and solidification of the oil allows for very efficient throughput rates during milling.

[00023] Flake milling, most commonly using a roller-type mill, was found to create a milled sabadilla seed that was somewhat more efficient to handle during processing than cryogenically hammer milled seed, but allowed a less efficient extraction. In a flake milling procedure, the seeds are heated to increase plasticity and passed between rollers which flatten the seeds into thin, solvent-penetrable flakes that are still largely one piece. Flaking usually produces a minimal amount of fine particles which hinder efficient processing.

[00024] Pin milling may also be used but this technique produces particles which are coarse and require more time to process than other milling products. Conventional, ambient, hammer milling and "Fitz" milling may also be used to produce a sufficiently sized particle, however, throughput rates are generally inefficient and it is difficult to control particle size.

[00025] While flake milling's larger particle size overall makes it simplest and easiest to handle during processing, Applicant found that cryogenic hammer milling allowed the creation of sabadilla seed particles over a range of sizes that enable a more efficient extraction of sabadilla oil with only a modest increase in material handling difficulty. Accordingly, Applicant found that cryogenic hammer milling with liquid nitrogen was a superior milling approach for producing sabadilla oil.

[00026] The milled sabadilla seeds can be washed with the seed or plant part solvent one time or multiple times. For example, the milled sabadilla seeds can be washed one to ten times. If the seed or plant part solvent is decanted and additional seed or plant part solvent added (additional washes), then the yield is increased.

[00027] The de-oiled milled sabadilla seeds can be washed with seed or plant part solvent one time or multiple times. For example, the de-oiled milled sabadilla seeds can be washed one to ten times. If the seed or plant part solvent is decanted and additional seed or plant part solvent is added (additional washes), then the purity of the extract is increased.

[00028] In an embodiment, the de-oiled milled sabadilla seeds are washed with the seed or plant part solvent from 1 to 5 times. In a preferred embodiment, the de-oiled milled sabadilla

seeds are washed with seed or plant part solvent from 2 to 5 times. In a most preferred embodiment, the milled sabadilla seeds are washed with seed or plant part solvent 5 times.

[00029] During the extraction, the de-oiled milled sabadilla seeds and seed or plant part solvent should be agitated. This can be done by any method known by those of skill in the art. Applicant found that stirring the de-oiled milled sabadilla seeds in the seed or plant part solvent increased the rate of extraction and was an effective means of agitation. The process was most efficient if the stirring was brisk enough to prevent the de-oiled milled sabadilla seeds from settling in the extraction vessel (*e.g.*, flask).

[00030] As used herein, the "seed or plant part solvent" refers to methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and/or 1-butanol.

[00031] In a preferred embodiment, the seeds or plant part solvent is selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, and propanol. In a more preferred embodiment, the seed or plant part solvent is methanol.

[00032] Methanol can be used at temperatures from about 0 to about 60 degrees Celsius. Applicant found that methanol at lower temperatures required additional extraction time and that temperatures above 55 to 60 degrees Celsius resulted in methanol loss and boiling. Applicant found that the optimal temperature for methanol extraction was from about 50 to about 55 degrees Celsius.

[00033] The milled sabadilla seeds can be washed with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives one time or multiple times. For example, the milled sabadilla seeds can be washed one to ten times. If the extract solvent is decanted and additional extract solvent is added (additional washes), then more oil is removed and the purity of the extract is increased.

[00034] As used herein, "extract solvent" refers to C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and/or benzene derivatives. As used herein, "benzene derivatives" refers to a chemical compound derived from benzene wherein one or more hydrogen atoms are replaced with another functional group. Examples of benzene derivatives include phenol, toluene, and aniline.

[00035] In a preferred embodiment, the extract solvent is hexane.

[00036] In an embodiment, the milled sabadilla seeds or other plant parts are washed with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives, from 1 to 5 times. In a preferred embodiment, the milled sabadilla seeds or other plant parts are washed with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives from 2 to 5 times. In a most preferred embodiment, the milled sabadilla seeds or other plant parts are washed with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives 5 times.

[00037] During the washes, the milled sabadilla seeds and at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives should be agitated. This can be done by any method known by those of skill in the art. Applicant found that stirring the milled sabadilla seeds in the extract solvent increased the rate of extraction and was an effective means of agitation.

[00038] Applicant found that using propylene glycol was critical to create the desired viscosity of the liquid sabadilla seed extract. Applicant tried another solvent, glycerol, but found that it was far too viscous.

[00039] In a further embodiment, the weight ratio of sabadilla extract to propylene glycol is from about 1:0.25 to about 1:10. In a preferred embodiment, the weight ratio of sabadilla extract to propylene glycol is from about 1:0.6 to about 1:1.3. In a more preferred embodiment, the weight ratio of sabadilla extract to propylene glycol is from about 1:0.8 to about 1:1.

[00040] In an alternative embodiment, butyl lactate is added to the sabadilla extract with the propylene glycol. In a preferred embodiment, the weight ratio of propylene glycol to butyl lactate is from about 1:0.25 to about 1:1. In a more preferred embodiment, the weight ratio of propylene glycol to butyl lactate is from about 1:1 to about 1:2. In a most preferred embodiment, the weight ratio of propylene glycol to butyl lactate is from about 1:2 to about 1:4.

[00041] In an embodiment, the weight ratio of butyl lactate to sabadilla extract is from about 1:0.2 to about 1:0.5. In a preferred embodiment, the weight ratio of butyl lactate to

sabadilla extract is from about 1:0.5 to about 1:0.6. In a more preferred embodiment, the weight ratio of butyl lactate to sabadilla extract is from about 1:0.6 to about 1:0.8.

[00042] Butyl lactate is also OMRI approved which means liquid sabadilla extract including this solvent can be used in organic farming.

[00043] In yet another embodiment, the methanol is removed from the sabadilla extract and propylene glycol by evaporation, including distillation.

[00044] In another embodiment, the present invention is directed to a liquid pesticidal sabadilla extract product produced by the process comprising the steps of milling sabadilla seeds, washing the milled sabadilla seeds with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives under agitation to dissolve the sabadilla oil, removing the extract solvent and sabadilla oil from the washed milled seeds, washing the de-oiled milled sabadilla seeds with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol under agitation to dissolve the sabadilla extract in the seed or plant part solvent, removing the seed or plant part solvent and sabadilla extract from the de-oiled washed milled seeds, adding propylene glycol to the sabadilla extract in the seed or plant part solvent, and removing the seed or plant part solvent from the sabadilla extract and propylene glycol to produce the liquid sabadilla extract.

[00045] In an alternative embodiment, the seed or plant part solvent can be entirely removed before the propylene glycol and/or butyl lactate are added.

[00046] In an embodiment, the at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives, and sabadilla oil are removed from the washed milled seeds by decanting (pouring), pumping, or draining. For example, when the extract is produced on a small scale, the milled seeds settle to the bottom of the flask and the extract solvent and sabadilla oil can be easily decanted out of the flask. During commercial extraction production, the extract solvent and sabadilla oil can be removed by methods known by those of skill in the art. For example, the extract solvent and sabadilla oil could be removed from the washing vessel by draining the solvent and sabadilla oil with the use of a screen, pump, or filter.

[00047] In another embodiment, sabadilla oil can be extracted from milled sabadilla seeds using countercurrent extraction. Countercurrent extraction is a commercial scale extraction process typically used in oil seed extraction of seeds such as canola and soy. In brief, countercurrent extraction is a continuous process in which fresh, milled seed is fed through a long solvent bath by conveyor. The seed enters one end and the solvent enters the other, both eventually exiting opposite ends of the apparatus as spent marc (i.e. extracted/depleted seed) and miscella (i.e. solvent with a solute load from the seed).

[00048] In an embodiment, the seed or plant part solvent and sabadilla extract are removed from the de-oiled milled sabadilla seeds by decanting (pouring), pumping, or draining. For example, when the extract is produced on a small scale, the milled seeds settle to the bottom of the flask and the methanol and sabadilla extract can be easily decanted out of the flask. During commercial extraction production, the seed or plant part solvent and sabadilla extract can be removed by methods known by those of skill in the art. For example, the methanol and sabadilla extract could be removed from the washing vessel by draining the seed or plant part solvent with the use of a screen, pump, or filter.

[00049] In a further embodiment, the present invention is directed to methods for controlling pests comprising applying the liquid sabadilla extract produced by the methods of the present invention to pests or the pests' environment.

[00050] In another embodiment, the pests controlled are selected from the group consisting of members of the class Insecta (insects), Arachnida subclass Acari (mites), and shell-less terrestrial gastropod mollusks (slugs).

[00051] In an embodiment, the insects controlled are selected from the group consisting of aphids (Hemiptera), whiteflies (Hemiptera), thrips (Thysanoptera), leafhoppers (Hemiptera), bed bugs (Hemiptera), psyllids (Hemiptera), scale insects (Hemiptera), mealybugs (Hemiptera), psocids (Psocoptera), lice (Phthiraptera), fleas (Siphonaptera), caterpillars (Lepidoptera), and early immature stages of beetles (Coleoptera), true bugs (Hemiptera), cockroaches (Blattodea), flies (Diptera) and wasps (Hymenoptera). In a preferred embodiment, the insects controlled are selected from the group consisting of aphids (Hemiptera), whiteflies (Hemiptera), thrips (Thysanoptera), leafhoppers (Hemiptera), bed bugs (Hemiptera), psyllids (Hemiptera), scale insects (Hemiptera), mealybugs (Hemiptera), psocids (Psocoptera), lice (Phthiraptera), and fleas

(Siphonaptera). In a more preferred embodiment, the insects controlled are selected from the group consisting of bed bugs (*Cimex lectularius*), western flower thrips (*Frankliniella occidentalis*), green peach aphids (*Myzus persicae*), and greenhouse whitefly (*Trialeurodes vaporariorum*).

[00052] In a preferred embodiment, the mites controlled are two-spotted spider mites (*Tetranychus urticae*).

[00053] The de-oiled sabadilla extract is a contact pesticide which means that the extract should be applied directly to the pests or their environment for the most effective control. The extract, or a formulation containing the extract, can be mixed with water and applied with a pressurized system, such as aerosol generators or in a form of ground application, *e.g.*, low pressure boom sprayers, high pressure sprayers, air blast sprayers, low volume air sprayers (mist blowers), hand-operated sprayers and pump sprays. The extract should be applied as a fine spray until the surface is uniformly wet with minimal runoff. In another embodiment, the extract can be formulated, for example, as granules, and applied by broadcast. In yet another embodiment, the extract could be formulated as a dust or wettable powder.

[00054] As used herein, "liquid sabadilla extract" refers to an extract of sabadilla seeds or other plant parts which has had the sabadilla oil and the solid inert parts (such as the cellulose, hemicellulose, lignin and pectin) removed in order to concentrate the alkaloids and to which propylene glycol has been added. "Liquid" refers to the sabadilla extract being pourable at 5 degrees Celsius and above.

[00055] The liquid sabadilla extract of the present invention is distinct from sabadilla seeds in their natural because the liquid sabadilla seed extract has been isolated from the seed and concentrated. Further, the liquid sabadilla extract includes propylene glycol. The liquid sabadilla extract of the present invention is not present in nature in this form.

[00056] As used herein, "controlling pests" refers to decreasing the negative impact of pests on plants or animals to a level that is desirable to the grower or animal.

[00057] As used herein, "roller mill" refers to equipment used to decrease the shape of a material by pressing the material with at least one cylindrical roller against another roller or firm surface. A roller mill is one way of producing a flaked seed.

[00058] As used herein, "pests' environment" refers to any area that the pest is present during any life stage. One environment likely to be treated by the methods of the present invention includes the plants that the pests are living on and the surrounding soil. The pests' environment may include soil, plants, harvested plants, gardens, fields, greenhouses, or other buildings, and various indoor surfaces and structures, such as furniture including beds, and furnishings including books, clothing, etc.

[00059] As used herein, all numerical values relating to amounts, weight percentages and the like are defined as "about" or "approximately" each particular value, namely, plus or minus 10% (± 10%). For example, the phrase "at least 5% by weight" is to be understood as "at least 4.5% to 5.5% by weight." Therefore, amounts within 10% of the claimed values are encompassed by the scope of the claims.

[00060] The articles "a," "an" and "the" are intended to include the plural as well as the singular, unless the context clearly indicates otherwise. For example, the methods of the present invention are directed to controlling "pests" but this can include control of a single pest (such as a single insect).

[00061] The following examples are intended to illustrate the present invention and to teach one of ordinary skill in the art how to use the extracts of the invention. They are not intended to be limiting in any way.

EXAMPLES

Example 1

[00062] Sabadilla seeds were milled using a roller mill according to the manufacturer's instructions. Two hundred grams of milled seed were added to a three liter flask with hexane and stirred with a three blade stirrer controlled by an overhead motor. This step removes the oil from the seeds. A stirring speed was maintained which prevented any seed fragments from settling in the flask. The system was sealed to limit evaporation loss.

[00063] The hexane was decanted off and additional hexane was added to the flask. This step was repeated three additional times. The hexane and remaining sabadilla seed oil (as a solute) were then decanted from the flask.

[00064] The hexane removed the oil from the milled seeds and de-oiled sabadilla seed remained in the flask.

[00065] The de-oiled sabadilla seed was then washed with methanol to remove the solid seed parts. The methanol was decanted off into a new flask and additional methanol was added to the flask. This step was repeated three additional times. The washed seeds remained in the washing flask.

[00066] Propylene glycol was then added to the methanol with the de-oiled sabadilla extract. The initial amount of propylene glycol added was 9% of the dry, de-oiled seed weight that comprised the batch.

[00067] Next, evaporation was used to remove the methanol, leaving a concentrated liquid sabadilla extract in the flask. Further, the extract could easily be adjusted to 10% alkaloid purity to create a standardized extract.

Example 2

[00068] The same procedure as explained in Example 1 was used except that butyl lactate replaced half of the propylene glycol. Accordingly, a liquid sabadilla extract was prepared.

Example 3

[00069] The same procedure as explained in Example 1 was used except that the methanol was removed by distillation. Standard IKA rotary evaporators were used for the distillation. A flask containing the methanol and de-oiled sabadilla extract were loaded into the evaporator and into a heated water bath. The flask was heated to between 50 to 55 degrees Celsius with a pressure below atmospheric in order to maximize efficient removal of the methanol without allowing it to boil over into the condenser. The evaporated methanol was thoroughly condensed in an adjoining flask leaving a concentrated liquid sabadilla extract in the flask.

CLAIMS

We claim:

1. A method for producing a liquid sabadilla extract comprising:

milling sabadilla seeds or other plant parts;

washing the milled sabadilla seeds or other plant parts with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives under agitation to dissolve the sabadilla oil;

removing the extract solvent and sabadilla oil from the washed milled seeds or other plant parts;

washing the de-oiled milled sabadilla seeds or other plant parts with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol under agitation to dissolve the sabadilla extract in the seed or plant part solvent;

removing the seed or plant part solvent and sabadilla extract from the de-oiled washed milled seeds or other plant parts;

adding propylene glycol to the sabadilla extract in the seed or plant part solvent; and

removing the seed or plant part solvent from the sabadilla extract and propylene glycol to produce the liquid sabadilla extract.

2. The method of claim 1 wherein the sabadilla seeds are *Schoenocaulon officinale* seeds.

3. The method of claim 1 wherein the weight ratio of sabadilla extract to propylene glycol is from about 1:0.25 to about 1:10.

4. The method of claim 1 wherein butyl lactate is added to the sabadilla extract with the propylene glycol.

5. The method of claim 4 wherein the weight ratio of propylene glycol to butyl lactate is from about 1:0.25 to about 1:4.

6. The method of claim 4 wherein the weight ratio of butyl lactate to sabadilla extract is from about 1:0.2 to about 1:0.8.

7. A liquid pesticidal sabadilla extract product produced by the process comprising the steps of:

milling sabadilla seeds or other plant parts;

washing the milled sabadilla seeds or other plant parts with at least one extract solvent selected from the group consisting of C5 to C14 alkanes, chlorinated methane, chlorinated ethane, benzene, and benzene derivatives under agitation to dissolve sabadilla oil;

removing the extract solvent and sabadilla oil from the washed milled seeds or other plant parts;

washing the de-oiled milled sabadilla seeds or other plant parts with at least one seed and plant part solvent selected from the group consisting of methanol, ethanol, glycol ether, ethyl lactate, propanol, butyl lactate, gamma-butyrolactone, and 1-butanol under agitation to dissolve the sabadilla extract in the methanol;

removing the seed or plant part solvent and sabadilla extract from the de-oiled washed milled seeds or other plant parts;

adding propylene glycol to the sabadilla extract in the seed or plant part solvent; and

removing the seed or plant part solvent from the sabadilla extract and propylene glycol to produce the liquid sabadilla extract.

8. The product of claim 7 wherein the sabadilla seeds are *Schoenocaulon officinale* seeds.

9. The product of claim 7 wherein the weight ratio of sabadilla extract to propylene glycol is from about 1:0.25 to about 1:10.

10. The product of claim 7 wherein butyl lactate is added to the sabadilla extract with the propylene glycol.

11. The product of claim 10 wherein the weight ratio of propylene glycol to butyl lactate is from about 1:0.25 to about 1:4.

12. The product of claim 11 wherein the weight ratio of butyl lactate to sabadilla extract is from about 1:0.2 to about 1:0.8.

13. A method for controlling pests comprising applying the liquid sabadilla extract produced by the method of claim 1 to pests or to the pests' environment.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/58079

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A01N 65/08, 65/42 (2016.01)
CPC - A01N 65/08, 65/42
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(8): A01N 65/08, 65/42 (2016.01)
CPC: A01N 65/08, 65/42

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 practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); EBSCO; Google Patents; Google Scholar; sabadilla, extract, wash, mill, grind, schoenocaulon officinale, seed, propylene glycol, butyl lactate, methanol, de-oil

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,078,211 A (ALLISON, JR et al.) 19 February 1963; column 1, lines 11-17, 25-49; column 2, lines 3-33, 53-60; column 3, lines 1-12	1-13
Y	US 6,309,678 B1 (KAHOL, AP et al.) 30 October 2001; column 2, lines 19-27, 48-49; column 6, lines 7-41	1-13
Y	WO 2009/031621 A1 (HIROYUKI, F et al.) 12 March 2009; English translation; page 2, paragraph [5]; page 3; page 13, paragraph [5]; claim 1	1-13
Y	US 2015/0216181 A1 (HERNANDEZ ROMERO, YM et al.) 06 August 2015; abstract; paragraph [0010]	2, 8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"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
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 November 2016 (30.11.2016)	13 JAN 2017

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