

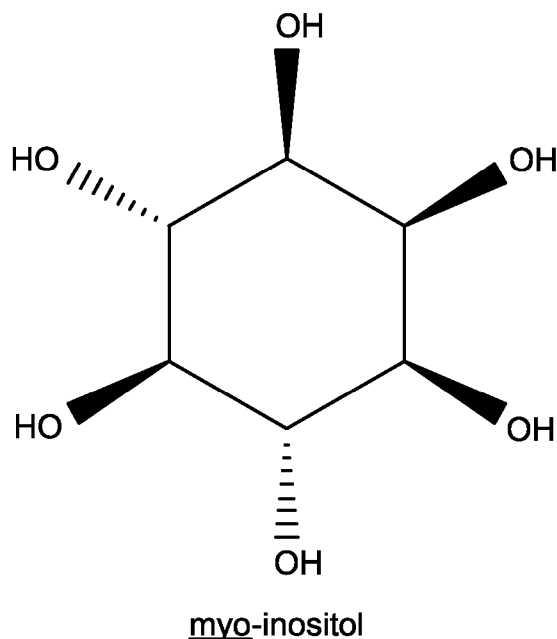


- (51) International Patent Classification:  
*A01N 25/00* (2006.01) *A01N 57/12* (2006.01)  
*A01N 31/04* (2006.01)
- (21) International Application Number:  
PCT/US2014/069319
- (22) International Filing Date:  
9 December 2014 (09.12.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
61/914,628 11 December 2013 (11.12.2013) US
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- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

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(54) Title: USE OF INOSITOLS AND PHOSPHATE SUBSTITUTED INOSITOLS AS TERMITICIDES

(57) Abstract: We disclose a novel termiticide, comprising a cyclic phenol, such as inositol, or a phosphate derivative of a cyclic phenol, such as phytate, combined with cellulose, and a method for using this novel termiticide.



**FIGURE 1**



HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

**(84) Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,

SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

**Published:**

- with international search report (Art. 21(3))

**USE OF INOSITOLS AND PHOSPHATE SUBSTITUTED  
INOSITOLS AS TERMITICIDES**

**CROSS-REFERENCE**

[0001] The present application claims the benefit of U.S. Provisional Patent Application, No. 61/914,628, filed on 11 December 2013, which is hereby incorporated by reference herein in its entirety, including but not limited to those portions that specifically appear herein.

**BACKGROUND OF THE INVENTION**

[0002] The present invention relates to a novel composition for controlling termites without the use of chemicals toxic to mammals. *Myo*-inositol, phytic acid (also known as phytate), and related compounds, when combined separately with a food source, for example, cellulose, are toxic to termites. *Myo*-inositol and phytic acid without a food source do not appear to be toxic to termites. With or without a food source, *myo*-inositol and phytic acid are non-toxic to mammals. These compositions were particularly effective in destroying Formosan subterranean termites, *Coptotermes formosanus* Shiraki.

[0003] Of the 28 species in the genus, the Formosan subterranean termite, *Coptotermes formosanus* Shiraki (*C. formosanus*) is the most destructive and economically important worldwide. *C. formosanus* infestations damage a wide variety of wooden structures, as well as over 50 species of living plants. They also cause damage to non-cellulosic materials such as insulation on buried electrical and telephone wires. The first general survey of an exotic *C. formosanus* infested region in the continental US was conducted in Louisiana in 1966, and since that time, the US populations of *C. formosanus* have grown rapidly. A study of this species in New Orleans, Louisiana showed that termite alates increased by a factor of fourteen over a seven year period.

[0004] *C. formosanus* digest their wood diets by utilizing exogenous endo- $\beta$ -1,4-glucanase (cellulose) and  $\beta$ -glucosidase (cellobiase) enzymes secreted into phagocytotic lumens by symbiotic hindgut protozoa that are crucial in cellulose and lignin metabolism. They also have endogenous endo- $\beta$ -1,4-glucanase and  $\beta$ -glucosidase enzymes expressed in the salivary glands and midgut. *Pseudotrichonympha grassii* Koidzumi, *Holomastigotoides hartmanni* Koidzumi and *Spirotrichonympha leidy* Koidzumi comprise the obligatory *C. formosanus* hindgut protozoan population, which themselves have obligatory intracellular bacterial symbionts. Coexisting with these organisms are numerous species of bacteria

involved in methanogenesis, acetogenesis, nitrogen fixation, sulfate reduction and oxygen scavenging that combine to form a complex and remarkable ancient micro-ecosystem.

[0005] A number of termiticides are known that effectively destroy termites, but all of these termiticides utilize termite poison of which most are also toxic to mammals, including humans.

[0006] Guadalupe, *et al.* (U.S. Patent Number 6,585,991) teaches the use of termite baits that comprise foods that attract termites along with termite poisons such as hexaflumuron, imisacloprin, fipronil, or other bioactive compounds.

[0007] Mervyn (U.S. Patent 6,413,551) teaches the use of compounds that produce effective amounts of hydrogen sulfide in situ.

[0008] Wright, *et al.* (EP 1 585 389) teaches the use of a combination of bifenthrin and acetamiprid for a continuous chemical barrier against termites.

[0009] However, we are not aware of any termiticide that effectively destroys termites without the use of termite poisons that have at least some toxicity towards mammals, and particularly, towards humans.

[0010] In addition to the more traditional insect poisons, some sugars have been tested for efficacy as an insecticide. For example, *D*-tagatose, a rare sugar, was found to be toxic to fly maggots, but not effective against termites. It was commercialized as Flycracker® by Biospherics, Inc. (Levin and Zehner 1992, Spherix 2002).

[0011] We are unaware, however, of any prior art that disclosed any sugar that showed toxicity toward termites.

## SUMMARY OF THE INVENTION

[0012] The inventions disclosed herein are novel method and compositions that are not harmful to mammals, and in particular, not harmful to humans, while exhibiting excellent toxicity towards termites. Further, this novel composition is particularly effective against Formosan subterranean termites, *Coptotermes formosanus* Shiraki. This composition comprises a mixture of a food source, for example, cellulose, and an environmentally compatible chemical, for example, various forms of Inositol and Phytate. In particular, we found that *myo*-inositol and phytate (*myo*-inositol-1,2,3,4,5,6-hexakisphosphate, also known as phytic acid), when combined with cellulose showed unexpected toxicity towards *C. Formosnus*.

[0013] There are nine isomeric forms of inositol (cyclohexanol), but the *myo*- is the most common form. (See Figure 1). At least five other isomeric forms of inositol have

been isolated, including *chiro*-, *epi*-, *muco*-, *neo*- and *scyllo*-inositols. Inositols, in general, and *myo*-inositol, in particular, are non-toxic to humans, and in fact, *myo*-inositol is sold as a dietary supplement for humans.

[0014] Phosphorylated *myo*-inositols are also common. The most abundant of these species is *myo*-inositol-1,2,3,4,5,6-hexakisphosphate, also known as phytic acid or phytate (See Figure 2). Phytate is accumulated in plant organs and tissues, including tubers, turions, roots and pollen, and is the principal form of phosphorus storage in seeds. Phytate is ubiquitous in eukaryotes. It is usually the most plentiful inositol derivative in cells where it, and other phosphorylated *myo*-inositol derivatives, is involved in numerous functions outside nutrient storage.

[0015] Other prior art has identified mixtures of cellulose with a variety of “nutrients,” including *myo*-inositol, as termite bait, but each of these inventions required the addition of a chemical toxic to termites for it to be an effective termiticide.

[0016] In addition, when termites are stripped of their protozoan symbionts caused by rearing termites on sugar supplemented agar diets, they exhibited significant mortality when the termites were switched back to cellulosic food sources.

[0017] In the present invention, we disclose a simple composition that is toxic to termites, but specifically excludes any additional chemical that is toxic to mammals. In our invention, we combined either a cyclophenolic compound, for example, *myo*-inositol, or a substituted cyclophenolic compound, for example, phytic acid, with a food source, for example, cellulose, to form a novel composition for termite destruction. It appears that these compounds could prove to be effective and inexpensive termiticides which are innocuous to humans and other mammals, and harmless to the environment.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Figure 1: Chemical structure of *myo*-inositol.

[0019] Figure 2: Chemical structure of phytate.

[0020] Figure 3: Percent mortality of *C. formosanus* following treatment of food source filter paper with *myo*-inositol

[0021] Figure 4: Percent mortality of *C. formosanus* following treatment of food source filter paper with *myo*-inositol or phytate.

## DETAILED DESCRIPTION OF THE INVENTION

[0022] We have discovered that cyclic hydroxyl-compounds, and more specifically cyclicphenols and phosphorylated cyclicphenols, when combined with cellulose, were toxic to termites, and in particular to *C. formosanus* and *C. formosanus* hindgut symbionts. We disclose a simple method to control termites by placing one of the cyclic hydroxyl compounds on an infested food source, such as cellulose. We found that *myo*-inositol or phytate was particularly toxic to termites when either compound was combined with cellulose in concentrations between about 300  $\mu\text{g}/\text{mm}^3$  to about 3000  $\mu\text{g}/\text{mm}^3$ . Figure 1 shows the structure of one isomer of inositol, *myo*-inositol. Figure 2 shows the structure of phytate.

[0023] *Myo*-inositol and phytate are toxic to Formosan subterranean termites only when the termites were consuming a food, such as cellulose, without the need to add another toxic compound to the mixture. *Myo*-inositol significantly increased mortality when applied to food source filter paper discs at 640.8 1281.7  $\mu\text{g}/\text{mm}^3$  and 1281.7  $\mu\text{g}/\text{mm}^3$  in three independent bioassays (Figures 3 and 4).

[0024] Phytate also significantly decreased feeding behavior at concentrations ranging from 320.4 - 1281.7  $\mu\text{g}/\text{mm}^3$  (Figure 4). *C. formosanus* termites can typically live in the absence of a food source for up to a month without significant mortality, although we have observed survival as long as 40 days without food. Therefore, with the observation of lower cellulose consumption, starvation did not explain the observed mortality. At the present, we are uncertain if the sugars act as feeding deterrents, or if decreased cellulose consumption is a symptom of an overall inositol/phytate-caused reduction in termite health.

[0025] Termites stripped of their protozoan symbionts by rearing on sugar supplemented agar diets, experienced significant mortality when switched back to cellulosic food sources. Although *myo*-inositol significantly reduces hindgut protozoan populations, its toxicity to symbiont populations appeared to be a secondary effect. *Myo*-inositol was not toxic to termites when it was administered in an agar rather than a cellulosic diet. While not wishing to be bound by this explanation, it appears that *myo*-inositol was not chemically changed following its consumption during the toxicity window, which may imply that it acted across the pre- or hindgut membrane, or it was not incorporated in a salvage pathway.

[0026] *C. formosanus* were destroyed following treatment of food source filter paper with *myo*-inositol in no-choice assays with twenty workers. Several separate collections were used and the data were recorded daily for fourteen days. We evaluated the

effectiveness of *myo*-inositol at the following concentrations of 160.2  $\mu\text{g}/\text{mm}^3$ , 320.4  $\mu\text{g}/\text{mm}^3$ , 640.8  $\mu\text{g}/\text{mm}^3$ , and 1281.7  $\mu\text{g}/\text{mm}^3$ . In addition, we examined the *C. formosanus* hindgut protozoan counts of workers for fourteen days while termites were allowed to feed on filter paper treated with 1281.7  $\mu\text{g}/\text{mm}^3$  of *myo*-inositol.

[0027] The effectiveness of this invention was tested under several scenarios based on worker *C. formosanus* collected from Brechtel Park, New Orleans, Louisiana. Open-mesh plastic containers filled with a lattice of southern yellow pine or spruce-pine-fir sapwood were buried near a *C. formosanus* infested tree and recovered after three to nine weeks.

[0028] Termite-containing crates were held in 250-liter plastic garbage cans kept at room temperature (26 -28 °C) and 70 - 80% relative humidity with the original food source.

[0029] Collections were as follows: 1 March 2008 (group A, *myo*-inositol radiotracer study); 9 May 2008 (group B, *myo*-inositol and *D*-glucose artificial agar diet termite assay); 29 May 2008 (group C, *myo*-inositol 1281.7, 640.8 and 320.4  $\mu\text{g}/\text{mm}^3$  dose mortality assay and *myo*-inositol and phytate 1281.7, 640.8 and 320.4  $\mu\text{g}/\text{mm}^3$  dose mortality assay); 20 March 2009 (group D, *myo*-inositol, 2-deoxy-*D*-galactose, *D*-glucose and *D*-galactose glucose artificial agar diet termite assay); 29 May 2009 (group E, *myo*-inositol 1281.7, 640.8, 320.4 and 160.2  $\mu\text{g}/\text{mm}^3$  dose mortality assay) and 11 May 2010 (group F, both *myo*-inositol and phytate protozoa quantitation).

[0030] Termites were extracted on moistened filter paper after tapping infested wood sticks into clean plastic containers.

#### EXAMPLE 1: Dose-Response

[0031] The effects of 1281.7, 640.8 and 320.4  $\mu\text{g}/\text{mm}^3$  treatments, of *myo*-inositol, were examined in three separate mortality bioassays.

[0032] Collection group E was used in the *myo*-inositol 1281.7, 640.8, 320.4 and 160.2  $\mu\text{g}/\text{mm}^3$  dose mortality assay.

[0033] In the remaining two assays, collection group C was used. We examined variation between groups collected from the field at different times, and also between groups collected from the same holding container at different times (C and C').

[0034] Results of ANOVA followed by Tukey's studentized range test indicated no inter-collection group variation in resistance to *myo*-inositol induced mortality at the 320.4  $\mu\text{g}/\text{mm}^3$  treatment level.

[0035] At the 640.8 and 1281.7  $\mu\text{g}/\text{mm}^3$  treatment levels, some variation was observed. Specifically, at the 640.8  $\mu\text{g}/\text{mm}^3$  dosage, mortality in group C' was significantly different from groups E and C on days four, five, and six.

[0036] At the same dose, mortalities in all three groups were different on days seven, and group E was different from groups C and C' on days eight, nine, and ten.

[0037] At a loading of 1281.7  $\mu\text{g}/\text{mm}^3$ , mortality in collection group E was significantly different than both collection group C and collection group C' on days two and three.

[0038] Test compounds were applied to 42.5 mm filter papers, in plastic Petri dishes measuring 60x15x5 mm. 1 mg of carbohydrate per 10  $\mu\text{L}$  of distilled water ( $\text{dH}_2\text{O}$ ) was the stock solution using 2.5 mg (160.2  $\mu\text{g}/\text{mm}^3$ ) of filter paper, 5 mg (320.4  $\mu\text{g}/\text{mm}^3$ ), 10 mg (640.8  $\mu\text{g}/\text{mm}^3$ ) and 20 mg (1281.7  $\mu\text{g}/\text{mm}^3$ ) of *myo*-inositol.

[0039] Phytate was tested with the three higher concentrations.  $\text{dH}_2\text{O}$  was added to bring the volume to 200  $\mu\text{L}$  and all control filter papers received 200  $\mu\text{L}$  of  $\text{dH}_2\text{O}$ .

[0040] To prevent desiccation, 100  $\mu\text{L}$  of  $\text{dH}_2\text{O}$  was applied to filter papers throughout the trials *pro re nata*, approximately every third day.

[0041] Twenty worker termites were acclimatized in the dark in a Parafilm<sup>®</sup> sealed Petri dish at room temperature for two weeks.

[0042] Termite mortality was recorded daily for fourteen days in triplicate experiments. A one-way analysis of variance (ANOVA), performed using SAS/STAT<sup>®</sup> software (version 9.1), followed by Tukey's studentized range test was used to evaluate statistical differences among groups (SAS Institute 2002). All mortality data were judged at  $\alpha = 0.05$ .

[0043] Termites from collection group C were used in both the *myo*-inositol 1281.7, 640.8 and 320.4  $\mu\text{g}/\text{mm}^3$  dose mortality assay and the *myo*-inositol and phytate 1281.7, 640.8 and 320.4  $\mu\text{g}/\text{mm}^3$  dose mortality assay, and termites from collection group E were used in the *myo*-inositol 1281.7, 640.8, 320.4 and 160.2  $\mu\text{g}/\text{mm}^3$  dose mortality assay.

[0044] Figure 3 shows the percent mortality of *C. formosanus* following treatment of food source filter paper with *myo*-inositol in no-choice assays with twenty workers ( $n=3$ ). Collection group C was used and the data were recorded daily for fourteen days. The *F* value for percent mortality is 212.68. *P* and *df* values are  $<0.0001$  and 74, 150.

[0045] Figure 4 shows percent mortality of *C. formosanus* following treatment of food source filter with *myo*-inositol or phytate in no-choice assays with twenty workers



(n=3). Collection group C was used and the data were recorded daily for fourteen days. The  $F$  value for percent mortality is 25.76.  $P$  and  $df$  values are <0.0001 and 119, 240.

[0046] Mortality was significant after three days in workers treated with both 1281.7 and 640.8  $\mu\text{g}/\text{mm}^3$  of *myo*-inositol compared with controls. The 640.8  $\mu\text{g}/\text{mm}^3$  treatment inducing 100% mortality by day seven, and the 1281.7  $\mu\text{g}/\text{mm}^3$  treatment by day five. The 320.4  $\mu\text{g}/\text{mm}^3$  treatment did not show significant mortality during the fourteen day assay (See Figure 3).

[0047] In a second test, the 1281.7  $\mu\text{g}/\text{mm}^3$  treatment using *myo*-inositol induced significant mortality after day four with 100% on day six. With phytate, significant mortality was exhibited after day seven with 100% on day ten. At 640.8  $\mu\text{g}/\text{mm}^3$ , *myo*-inositol caused significant mortality after day six with 100% on day ten, and phytate results were significant after day twelve with 73% mortality by day fourteen. At 320.4  $\mu\text{g}/\text{mm}^3$ , *myo*-inositol did not cause significant mortality, while the phytate showed significant mortality after day eleven and 62% mortality after day fourteen.

[0048] In a third test at day fourteen, mortality was not significant with 160.2 or 320.4  $\mu\text{g}/\text{mm}^3$  *myo*-inositol. The 640.8  $\mu\text{g}/\text{mm}^3$  levels became significant on day seven. The 1281.7  $\mu\text{g}/\text{mm}^3$  levels were significant after day one with 100% mortality on day six.

## EXAMPLE 2: Protozoan Counting

[0049] The effect of *myo*-inositol and phytate on *C. formosanus* hindgut protozoan populations was examined as follows: Twenty milligrams of *myo*-inositol or phytate were dissolved in 200  $\mu\text{l}$  of  $\text{dH}_2\text{O}$  and applied to filter paper in a 60x15x5 mm plastic Petri dish (1281.7  $\mu\text{g}/\text{mm}^3$ ). Control filter paper received 200  $\mu\text{l}$  of  $\text{dH}_2\text{O}$ .

[0050] Seventy-five worker termites were placed in each dish and collection group F was used in both *myo*-inositol assays and the phytate assay. *Pseudotrichonympha grassii* Koidzumi, *Holomastigotoides hartmanni* Koidzumi and *Spirotrichonympha leidy* Koidzumi were counted daily for two weeks.

[0051] Hindguts were removed from three workers and gently macerated in 40  $\mu\text{l}$  of saline solution containing neutral red dye (0.5 mL of 1% aqueous neutral red solution dissolved in 10 mL saline solution).

[0052] The number of each protozoan species was determined with a hemocytometer under a light microscope. The population of each protozoan species per hindgut ( $X_F$ ) was calculated as:  $X_F = (G \times n) / (V \times 3)$ , where  $G$  = volume ( $\mu\text{l}$ ) of solution

hindguts dissected in;  $n$  = mean of two counts within hemocytometer;  $V$  = volume ( $\mu$ l) of area counted.

[0053] Mean ( $\pm$ SE)  $X_F$  values calculated from two replicates were used for graphical comparison of data. Protozoan population data were subjected to ANOVA followed by a Tukey's studentized range test, and all data were judged at  $\alpha = 0.05$ . A square root transformation was applied for data analysis; however, untransformed means are reported.

[0054] *Myo-inositol bioassay*: Test one for filter paper treated with 1281.7  $\mu$ g/mm<sup>3</sup> of *myo*-inositol on total protozoan populations showed significance on day three for *P. grassii*, and reduced populations on days four, five and eight. *H. hartmanni* and *S. leidy*, showed significance on days four through eight, and reduced populations on days eleven and thirteen, respectively.

[0055] In a second test with 1281.7  $\mu$ g/mm<sup>3</sup> *myo*-inositol treated protozoan populations, changes became significant on days eight through eleven with *P. grassii* populations being significantly lower than controls on days four, five, seven, eight, ten and eleven. *H. hartmanni* populations were also significantly reduced on days seven, eight, ten and eleven.

[0056] A 1281.7  $\mu$ g/mm<sup>3</sup> treatment of phytate on filter paper did not significantly reduce any of the three protozoan populations.

### EXAMPLE 3: *Myo*-Inositol Feeding without Cellulose

[0057] Artificial diets were prepared by dissolving 400 mg/10 mL of selected sugars in 150 mg/10 mL of agar in distilled water with a pH of 6.8. Sugar and agar solutions were autoclaved separately. Agar-sugar solutions were poured into polystyrene Petri dishes measuring 60x15x5 mm, allowed to solidify, and then divided into quadrants.

[0058] *Myo*-inositol, D-glucose, 2-deoxy-D-galactose and D-galactose were all examined as carbon sources along with a control of unsupplemented agar. In triplicate experiments, twenty worker termites from collection group B for the *myo*-inositol and D-glucose (40mg/mL agar) assay, or collection group D for the *myo*-inositol, D-glucose, D-galactose, 2-deoxy-D-galactose (40mg/mL agar) and agar alone assay, again were placed in polystyrene Petri dishes measuring 60x15x5 mm and provided with an agar-sugar quadrant to serve as a food and water source.

[0059] After fourteen days, termites were removed from the dishes. Mortality data were subjected to ANOVA followed by Tukey's studentized range test. All mortality data were judged at  $\alpha = 0.05$ .

[0060] *Myo*-inositol, D-galactose and D-glucose diets all failed to induce mortality significantly different from the agar alone group, all resulting in less than 9% mortality after fourteen days.

[0061] When these compounds were tested with agar alone, *myo*-inositol, D-galactose and D-glucose diets all failed to induce mortality significantly different from the agar alone group, all resulting in less than 9% mortality after fourteen days.

## CLAIMS

- Claim 1      A termiticide composition essentially consisting of a cycloaliphatic phenol and cellulose, without chemicals that are toxic to mammals.
- Claim 2      A composition according to Claim 1 wherein the cycloaliphatic phenol comprises inositol.
- Claim 3      A composition according to Claim 2 wherein the inositol comprises myo-inositol.
- Claim 4      A composition according to Claim 1 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of the cycloaliphatic phenol is placed on cellulose.
- Claim 5      A composition according to Claim 1 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of cycloaliphatic phenol is placed on cellulose.
- Claim 6      A composition according to Claim 2 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of inositol is placed on cellulose.
- Claim 7      A composition according to Claim 2 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of inositol is placed on cellulose.
- Claim 8      A composition according to Claim 3 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of *myo*-inositol is placed on cellulose.
- Claim 9      A composition according to Claim 3 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of *myo*-inositol is placed on cellulose.
- Claim 10     A termiticide composition essentially consisting of a phosphorylated cycloaliphatic phenol and cellulose, without chemicals that are toxic to mammals.
- Claim 11     A composition according to Claim 10 wherein the phosphorylated cycloaliphatic phenol comprises inositol-1,2,3,4,5,6-hexaphosphate.
- Claim 12     A composition according to Claim 11 wherein the inositol-1,2,3,4,5,6-hexaphosphate comprises phytate.

Claim 13 A composition according to Claim 10 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of the phosphorylated cycloaliphatic phenol is placed on cellulose.

Claim 14 A composition according to Claim 10 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of phosphorylated cycloaliphatic phenol is placed on cellulose.

Claim 15 A composition according to Claim 11 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of inositol-1,2,3,4,5,6-hexaphosphate is placed on cellulose.

Claim 16 A composition according to Claim 11 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of inositol-1,2,3,4,5,6-hexaphosphate is placed on cellulose.

Claim 17 A composition according to Claim 12 wherein between about 300  $\mu\text{g}/\text{mm}^3$  and 1400  $\mu\text{g}/\text{mm}^3$  of phytate is placed on cellulose.

Claim 18 A composition according to Claim 12 wherein between about 500  $\mu\text{g}/\text{mm}^3$  and 1280  $\mu\text{g}/\text{mm}^3$  of phytate is placed on cellulose.

Claim 19 A method for controlling termites comprising the use of an effective amount of a cycloaliphatic phenol placed on a cellulose containing material at a location in which termites are present or expected to be present.

Claim 20 A method according to Claim 19 wherein the cycloaliphatic phenol comprises inositol.

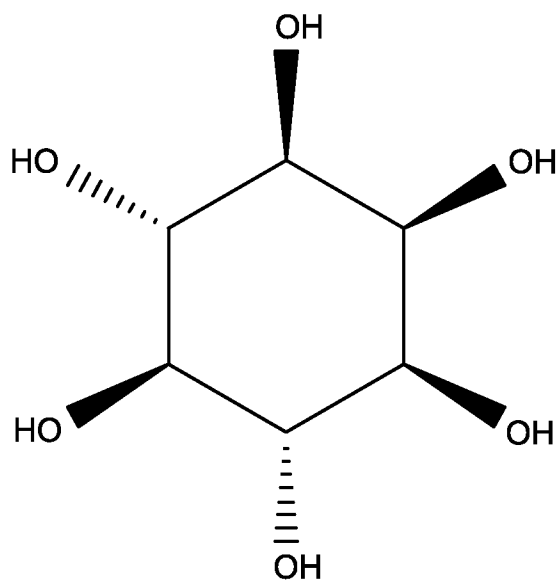
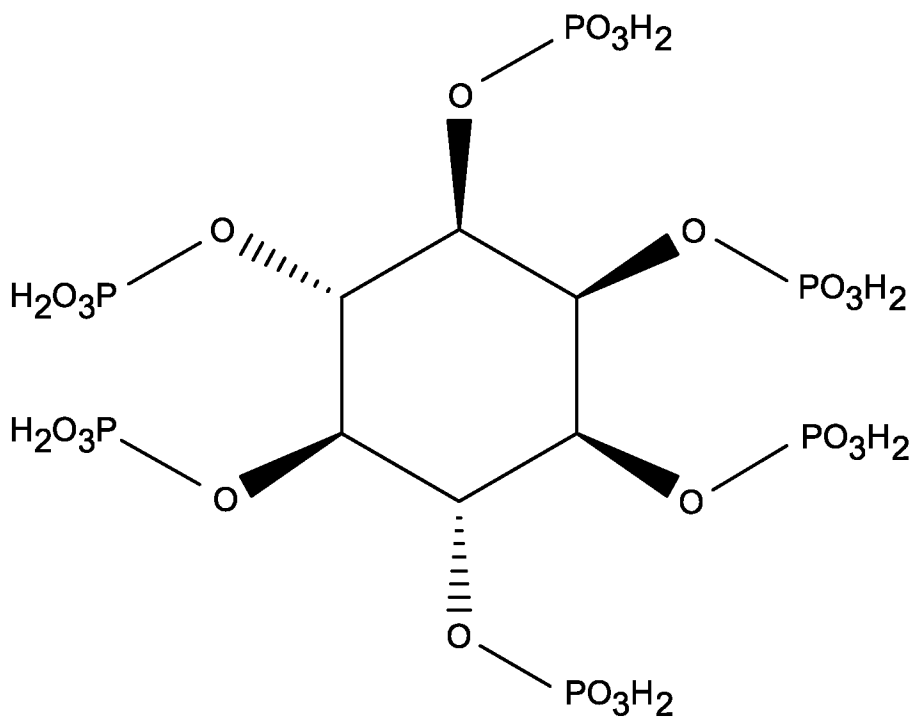
Claim 21 A method according to Claim 20 wherein the inositol comprises *myo*-inositol.

Claim 22 A method for controlling termites, comprising the use of an effective amount of a phosphorylated cycloaliphatic phenol placed on a cellulose containing material at a location in which termites are present or expected to be present.

Claim 23 A method according to Claim 22 wherein the phosphorylated cycloaliphatic phenol comprises inositol-1,2,3,4,5,6-hexaphosphate.

Claim 24      A method according to Claim 23 wherein the inositol-1,2,3,4,5,6-hexaphosphate comprises phytate.

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myo-inositol**FIGURE 1****FIGURE 2**

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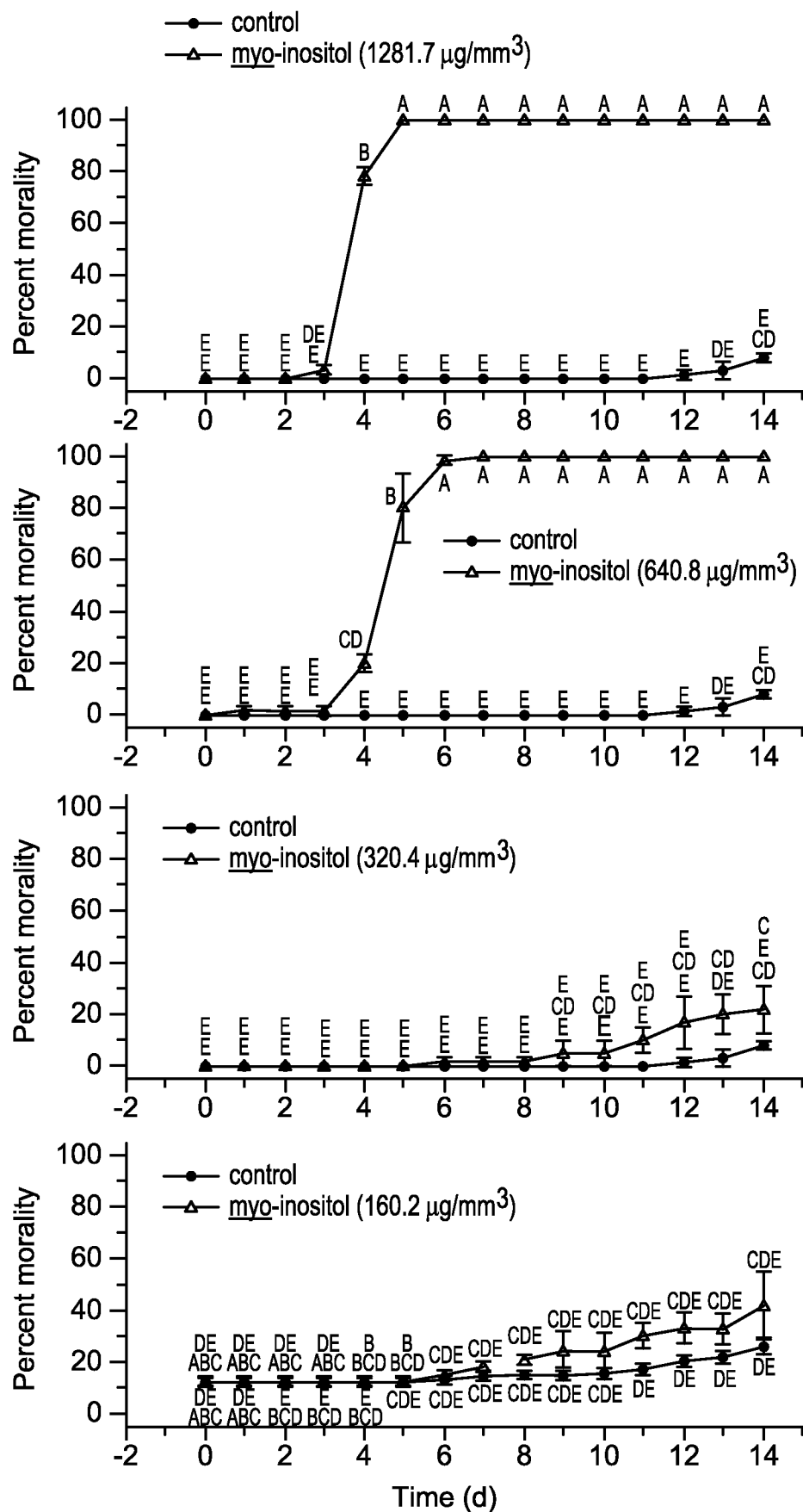


FIGURE 3



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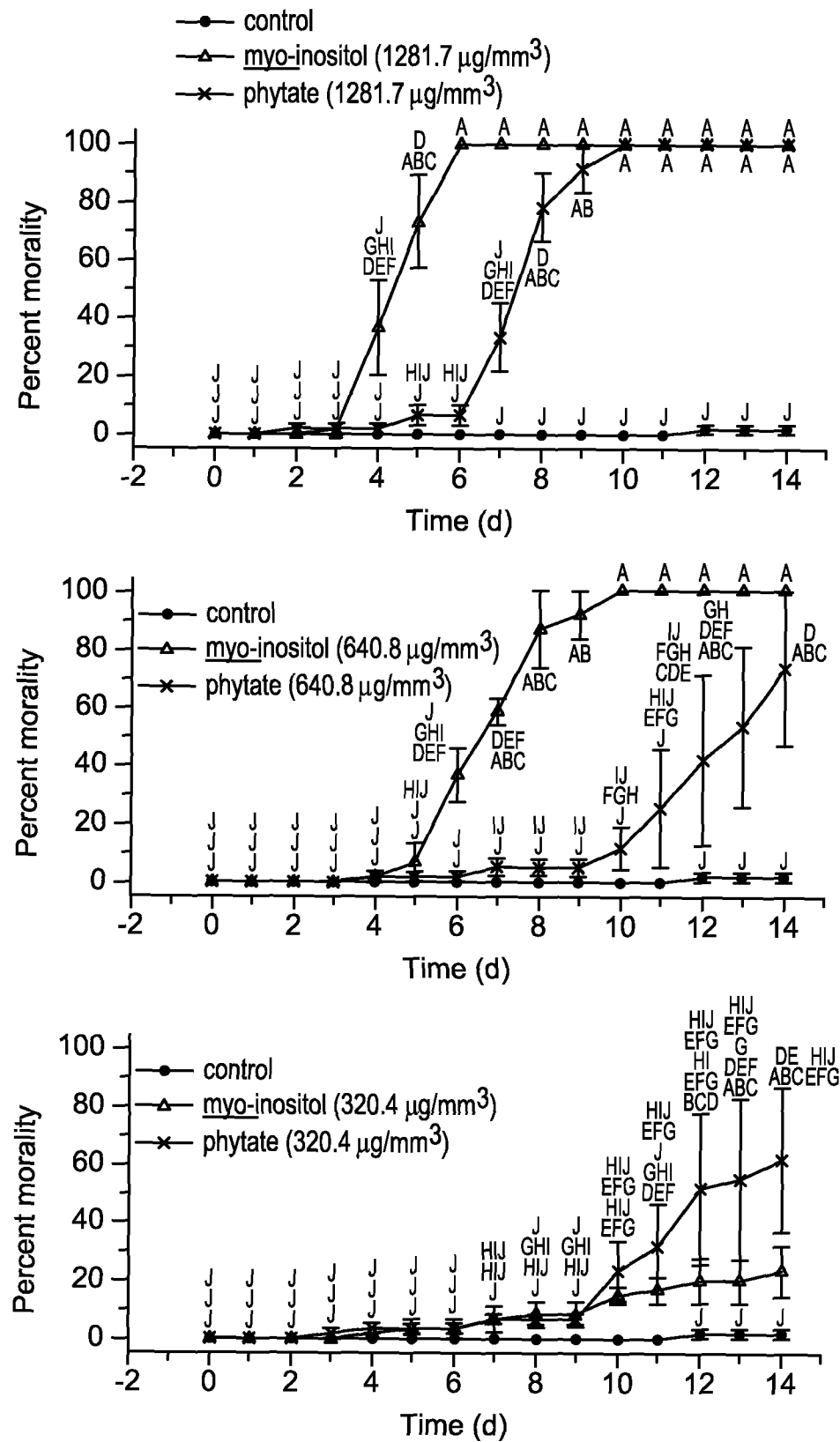


FIGURE 4

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2014/069319

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A01N25/00 A01N31/04 A01N57/12  
ADD.

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)

A01N

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

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

EPO-Internal, CHEM ABS Data, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Relevant to claim No. |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | VEILLON LUCAS JAMES: "The Biological Activity of rare carbohydrates and cyclitols in coptotermes formosanus",<br>27 October 2011 (2011-10-27), XP002735188,<br>Retrieved from the Internet:<br>URL: <a href="http://etd.lsu.edu/docs/available/etd-11082011-160845/unrestricted/LucasVeillon.Dissertation.pdf">http://etd.lsu.edu/docs/available/etd-11082011-160845/unrestricted/LucasVeillon.Dissertation.pdf</a><br>[retrieved on 2015-01-29]<br>Chapters 3-4; Appendix; Fig. 14, page 55;<br>Fig 21, page 65; pages 97-98<br>----- | 1-24                  |
| X         | US 2002/172658 A1 (BRODE PHILIP FREDERICK [US] ET AL BRODE III PHILIP FREDERICK [US] ET A) 21 November 2002 (2002-11-21)<br>Reference Example 3, Table VI-VII (CAS N° 80-04-6), Claims 1-6, 8-12, 14-37<br>-----<br>-/--                                                                                                                                                                                                                                                                                                               | 1,4,5,19              |

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

30 January 2015

Date of mailing of the international search report

13/02/2015

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | WO 00/62610 A1 (US AGRICULTURE [US])<br>26 October 2000 (2000-10-26)<br>Example 1 (table 2), pages 13-14; claims<br>1, 10                                                                                                                                                                                                                                    | 1-9,<br>19-21         |
| X         | -----<br>JUDITH REINHARD: "Thin-Layer<br>Chromatography assessing feeding<br>stimulation by labial gland secretion<br>compared to synthetic chemicals in the<br>subterranean termite Reticulitermes<br>santonensis",<br>JOURNAL OF CHEMICAL ECOLOGY,<br>vol. 27, no. 1, 2001, pages 175-187,<br>XP002735254,<br>page 178, 180, Table 2 (m-inositol)<br>----- | 1-9,<br>19-21         |

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No

PCT/US2014/069319

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2002172658 A1                          | 21-11-2002          | AU 2002248518 B2           | 17-08-2006          |
|                                           |                     | US 2002172658 A1           | 21-11-2002          |
|                                           |                     | US 2004170661 A1           | 02-09-2004          |
|                                           |                     | WO 02069704 A2             | 12-09-2002          |
| -----                                     |                     |                            |                     |
| WO 0062610 A1                             | 26-10-2000          | AU 768660 B2               | 18-12-2003          |
|                                           |                     | AU 4217400 A               | 02-11-2000          |
|                                           |                     | EP 1170996 A1              | 16-01-2002          |
|                                           |                     | JP 5047417 B2              | 10-10-2012          |
|                                           |                     | JP 2002542171 A            | 10-12-2002          |
|                                           |                     | US 6585991 B1              | 01-07-2003          |
|                                           |                     | WO 0062610 A1              | 26-10-2000          |
| -----                                     |                     |                            |                     |