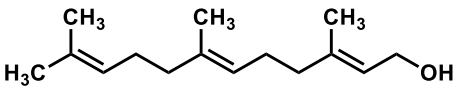
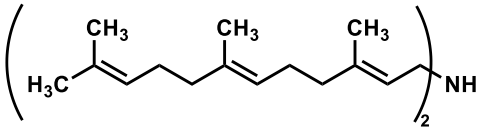
Claims

1. A method of preparing squalene comprising (1) reacting *trans, trans*-farnesol

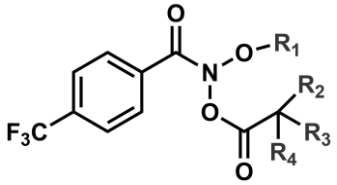


with reagents to form bis-farnesylamine

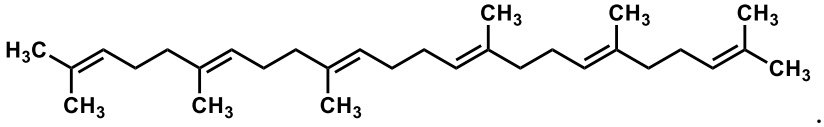


; and

(2) reacting bis-farnesylamine with



wherein **R1** is benzyl, and **R2**, **R3**, and **R4** are independently $C_{1\text{-}10}$ alkyl, to form squalene

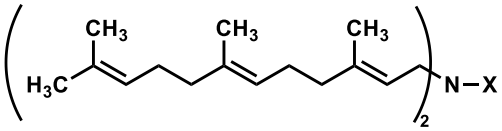


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2. The method of claim 1, wherein **R2**, **R3**, and **R4** are methyl.

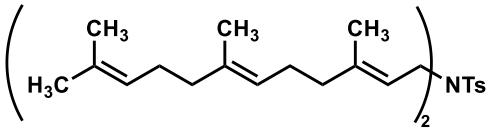
3. The method of claim 1, wherein the reagents in step (1) & (2) are p-toluene sulfonamide, cyanomethylenetributylphosphorane (CMBP) and sodium naphthalene.

4. The method of claim 1, wherein in step (1) *trans, trans*-farnesol is reacted with reagents to form an intermediate



wherein **X** is tosylate and the intermediate is reacted with sodium naphthalene to form bis-farnesylamine, may be trityl which is reacted with any acid, or may be nosyl which is reacted with thioglycolic acid and a base to form bis-farnesylamine.

5. The method of claim 3, wherein in step (1) *trans, trans*-farnesol is reacted with p-toluenesulfonamide and (Tributylphosphoranylidene)acetonitrile solution or cyanomethylenetributylphosphorane (CMBP) to form bis-farnesyl-tosylamine



and then bis-farnesyl-tosylamine is reacted with sodium naphthalene to form bis-farnesylamine.

6. The method of claim 1, wherein the synthesis occurs in the absence of a transition metal catalyst.

7. A composition comprising substantially pure squalene prepared using the method of claim 1, wherein the substantially pure squalene comprises greater than 98% squalene by weight.

8. A method of making a vaccine formulation comprising adding the substantially pure squalene of claim 7 into an oil-in-water emulsion to form a vaccine formulation.

9. A method of making a drug delivery formulation comprising adding the substantially pure squalene of claim 7 into an oil-in-water emulsion to form a drug delivery formulation.

10. A method of making a cosmetic formulation comprising adding the substantially pure squalene of claim 7 into a cosmetic formulation.

11. A method of improving anti-inflammatory and antioxidant properties of lipid nanoparticle (LNP) formulations comprising adding the substantially pure squalene of claim 7 into a lipid nanoparticle formulation.

12. The method of claim 1, wherein the reagent in step (1) is 2-Nitrobenzenesulfonamide.

13. A high purity squalene composition comprising squalene with a purity of at least 98% by weight and less than 1ppm heavy metals.