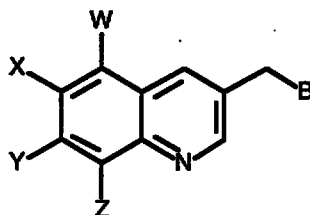


SUBSTITUTED QUINOLINE HERBICIDE INTERMEDIATES
AND PROCESS

The invention relates to substituted quinoline herbicide intermediates useful in the
 5 synthesis of the herbicides. More particularly the invention concerns 3-substituted
 quinolines useful in the synthesis of 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolidinyl)-5-
 methoxymethylnicotinic acid. The invention further provides a process for preparing 3-
 alkoxymethyl substituted quinoline herbicide intermediates.

10 **Detailed Description**

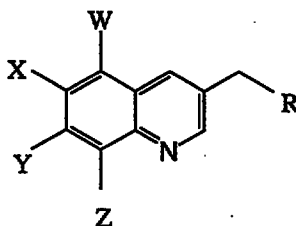
The invention provides compounds of the formula



15 wherein W, X and Y are independently H, halogen, NO₂, NH₂ or -O-alkyl straight or
 branched C₁-C₆; Z is H, halogen, NO₂, NH₂, OH or -O-alkyl straight or branched C₁-
 C₆ and B is chlorine, bromine, a quaternary ammonium halide or -O-alkyl straight or
 20 branched C₁-C₆;

with the proviso that when the following values of B, W, X, and Y are taken
 simultaneously: B is -O-alkyl straight or branched C₁-C₆; W is H; X is H and Y is H,
 then Z is not OH or -O-alkyl straight or branched C₁-C₆.

25 The invention further provides a process for preparing a compound of the formula



or wherein W, X and Y are independently H, halogen, NO₂, NH₂ or -O-alkyl straight
 30 or branched C₁-C₆; Z is H, halogen, NO₂, NH₂, OH or -O-alkyl straight or branched

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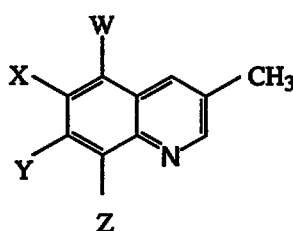
C₁-C₆ and B is chlorine, bromine, a quaternary ammonium halide or -O-alkyl straight or branched C₁-C₆;

- with the proviso that when the following values of B, W, X, and Y are taken simultaneously: B is -O-alkyl straight or branched C₁-C₆; W is H; X is H and Y is H, then Z is not OH or -O-alkyl straight or branched C₁-C₆, which comprises

(a) reacting a compound of the formula II

10

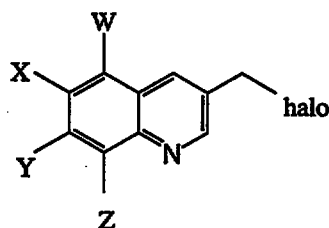
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II

- wherein W, X, Y and Z are independently H, halogen, NO₂, -O-alkyl straight or branched C₁-C₆ with a radical halogenating reagent wherein the halogen is bromine or chlorine to form a compound of the formula III wherein halo is chlorine or bromine

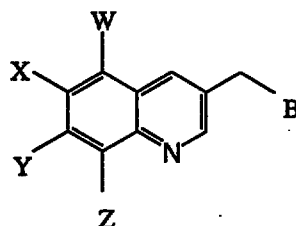
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III

- (b) reacting compound III with a tertiary amine to form a compound of the formula IV

20



IV

wherein B is a tertiary ammonium halide; and

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(c) reacting compound IV with ROM a metal alkoxide, wherein R is alkyl straight or branched C₁-C₆ and M is Na, Li or K to form the compound of formula I and

5 (d) if desired converting the compound of formula I or protected amino derivative thereof obtained to a further compound of formula I.

The term alkyl used herein, as a group or a part of a group, includes straight chain and branched chain, e.g. methyl, ethyl, isopropyl and isobutyl.

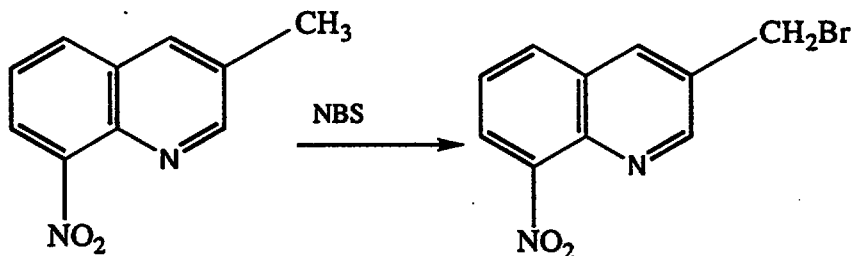
10 The 3-alkoxymethyl substituted quinolines of the invention are herbicide intermediates useful in the synthesis of the substituted quinoline herbicide intermediates to the herbicide intermediate 5-methoxymethyl-2,3-pyridinedicarboxylic acid for the herbicide 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolidinyl)-5-methoxymethylnicotinic acid of U.S. Patent 5,334,576.

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The invention is further illustrated in the examples, below, but is not to be deemed limited thereby.

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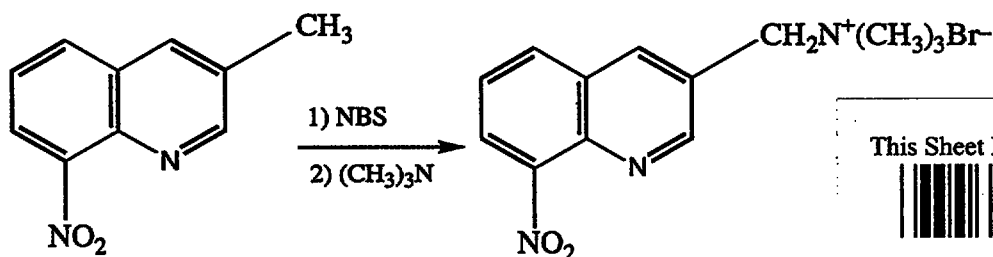


EXAMPLE 1: Preparation of 3-(Bromomethyl)-8-nitroquinoline

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A stirred mixture of 3-methyl-8-nitroquinoline (9.5 g, 0.05 mol) in chlorobenzene (75 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (9.0g 0.05 mol), and 2,2'-azobisisobutyronitrile (0.5 g, 0.003 mol) is added to the reaction mixture. The reaction mixture is held at 80-90°C for 1 hour. The mixture is washed with water (100 mL) at 60-80°C, cooled to room temperature and filtered to obtained a solid. The solid is washed with chlorobenzene and vacuum dried to give the title product as light-yellow solid (3.9 g mp 121-124°C) which is identified by ^1H and ^{13}C NMR spectral analyses.

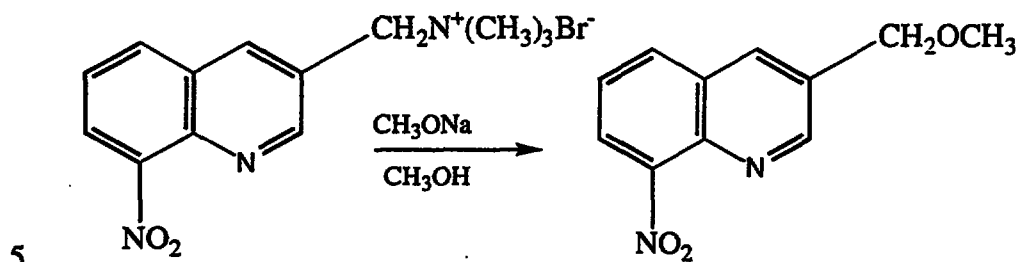
15 **EXAMPLE 2: Preparation of (8-Nitro-3-quinolyl) methyltrimethyl-ammonium bromide**



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20 A stirred mixture of 3-methyl-8-nitroquinoline (75 g, 0.40 mol) in chlorobenzene (1000 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (75g 0.42 mol), and 2,2'-azobisisobutyronitrile (4 g, 0.024 mol) is added to the reaction mixture over 30 minutes at 80-90°C. After the addition is complete, the reaction mixture is held a 80-90°C mL). The mixture is cooled to 10°C and anhydrous trimethylamine (49 g, 0.83 mol) is added. The mixture is stirred overnight at 10-30°C and filtered to obtained a solid. The solid is washed with acetone and vacuum dried to give the title product as light-yellow solid (74.0 g) which is identified by ^1H and ^{13}C NMR spectral analyses.

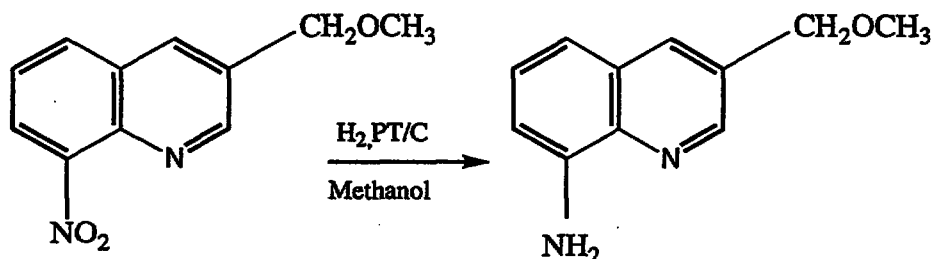
EXAMPLE 3: Preparation of 3-(Methoxymethyl)-8-nitroquinoline

A mixture of 25% sodium methoxide(88 g, 0.19 mol) in methanol (600 mL) and (8-nitro-3-quinolyl) methyltrimethylammonium bromide(63 g, 0.19 mol) is heated under nitrogen at reflux for 2 hours and cooled to room temperature. The resulting mixture is diluted with ice water (600 mL) and filtered to obtained a solid. The solid is washed with water and vacuum dried to give the title product as an off-white solid (32.2 g, mp 69-71°C) which is identified by ^1H and ^{13}C NMR spectral analyses.

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EXAMPLE 4: Preparation of 3-(Methoxymethyl)-8-aminoquinoline

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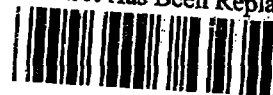


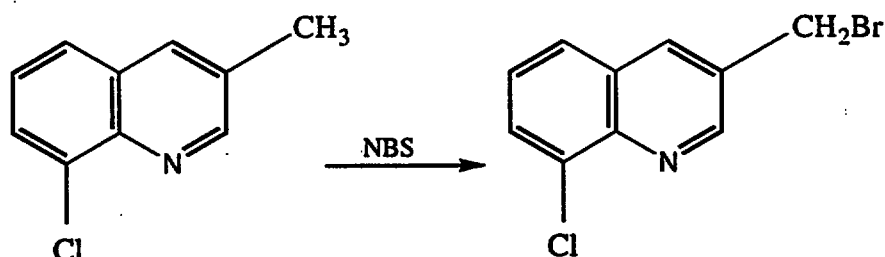
A mixture of 3-(methoxymethyl)-8-nitroquinoline (5.64g 0.026 mol), 5% palladium on carbon (0.32g) and methanol (70 mL) in a pressure vessel is heated to 45°C. The mixture is treated with hydrogen at 30 psig for 4 hours at 45°C and cooled to room temperature. The mixture is filtered to remove the palladium on carbon and the cake is washed with methanol. The combined filtrate and wash is concentrated in vacuo to obtain the title product as a clear liquid (4.7 g) which is identified by ^1H and ^{13}C NMR spectral analyses.

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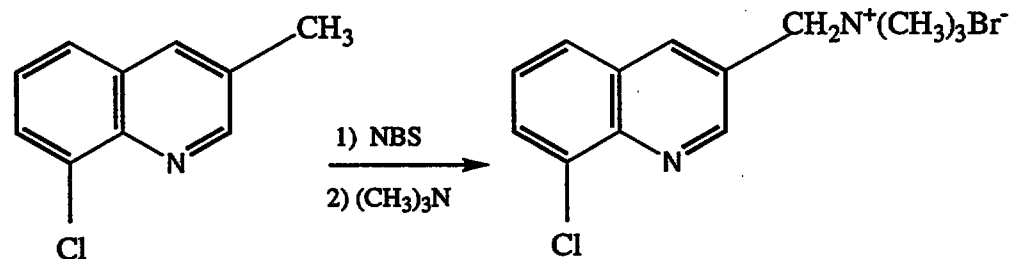
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EXAMPLE 5: Preparation of 3-(Bromomethyl)-8-chloroquinoline

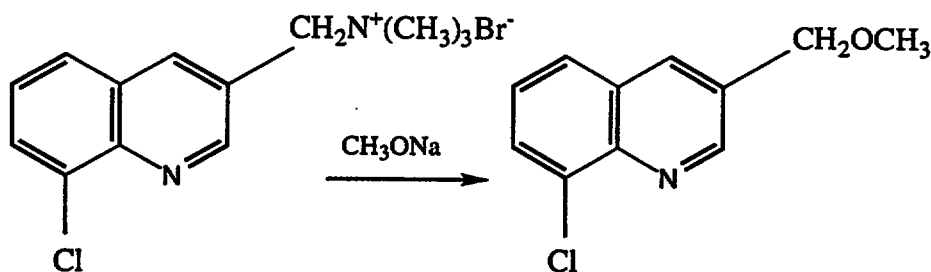
- 5 A stirred mixture of 3-methyl-8-chloroquinoline (9 g, 0.05 mol) in chlorobenzene (75 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (9.0g 0.05 mol) and 2,2'-azobisisobutyronitrile (0.5 g, 0.003 mol) is added to the reaction mixture. The reaction mixture is held at 80-90°C for 1 hour. The mixture is washed twice with water (50 mL) at 60-80°C and cooled to room temperature. The mixture is diluted with
- 10 heptane (75 mL) and filtered to obtain a solid which is washed with chlorobenzene and then with heptane. The solid is vacuum dried to give the title product as an off-white solid (6.2 g, mp 125-129°C) which is identified by ¹H and ¹³C NMR spectral analyses.

EXAMPLE 6: Preparation of (8-Chloro-3-quinolyl)methyltrimethyl-ammonium bromide

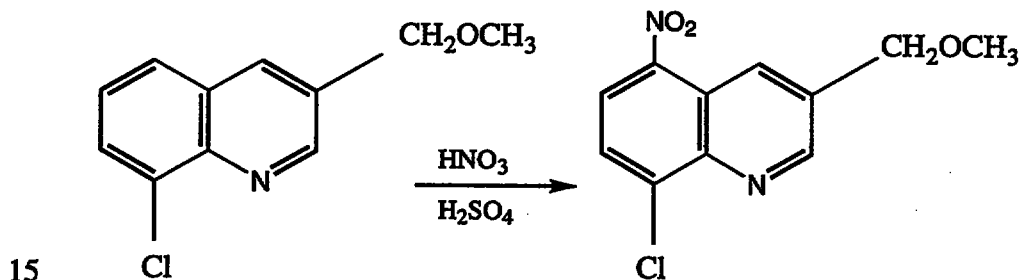
- 20 A stirred mixture of 3-methyl-8-chloroquinoline (71.2 g, 0.4 mol) in chlorobenzene (700 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (71.2g, 0.4 mol) and 2,2'-azobisisobutyronitrile (4 g, 0.024 mol) is added to the reaction mixture over 30 minutes at 80-90°C. After the addition is complete, the reaction mixture is held at 80-90°C for 1.5 hours. The mixture is washed twice with water (300 mL) at 60-80°C and the organic mixture is diluted with acetone (250 mL). The mixture is cooled to 10°C
- 25 and anhydrous trimethylamine (29.5g, 0.5 mol) is added. The mixture is stirred at 10-30°C for 3 hours and filtered to obtain a solid. The solid is washed with acetone and vacuum dried to give the title product as an off-white solid (69.4 g) which is identified by ¹H and ¹³C NMR spectral analyses.



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EXAMPLE 7: Preparation of 3-(Methoxymethyl)-8-chloroquinoline

- 5 A mixture of 25% sodium methoxide (66 g, 0.3 mol) in methanol (600 mL) and (8-chloro-3-quinolyl) methyltrimethylammonium bromide (66 g, 0.21 mol) is heated under nitrogen at reflux for 3 hours and cooled to room temperature. The resulting mixture is diluted with ice water (500 mL) and extracted twice with methylene chloride (200 mL). The extracts are combined, washed with water, and concentrated in vacuo to obtain the
- 10 title product as a clear liquid (39.4 g) which is identified by ^1H and ^{13}C NMR spectral analyses.

EXAMPLE 8: Preparation of 3-(Methoxymethyl)-5-nitro-8-chloroquinoline

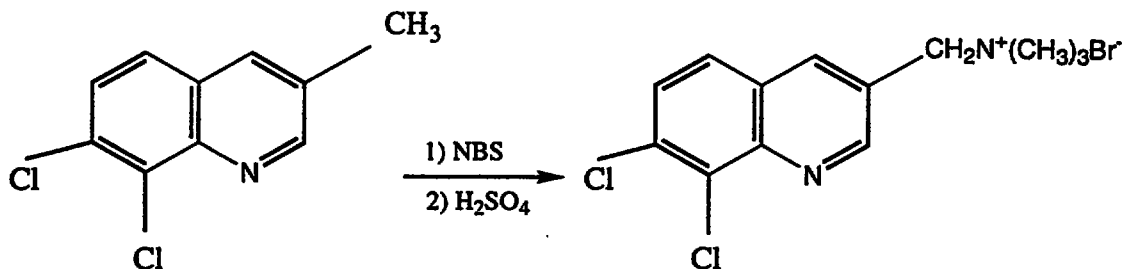
- 15 3-(Methoxymethyl)-8-chloroquinoline (10.3g, 0.05 mol) is added to 96% sulfuric acid (40 g, 0.39 mol) at 10-30°C and 70% nitric acid is then added over 15 minutes. The reaction mixture is stirred at room temperature for 14 hours, diluted with ice water (150 mL) and filtered to obtain a solid. The solid is washed with water and vacuum dried to
- 20 give the title product as a yellow solid (9.4 g, mp 83-86°C) which is identified by ^1H and ^{13}C NMR spectral analyses.

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EXAMPLE 9: Preparation of (7,8-Dichloro-3-quinolyl) methyltrimethylammonium bromide

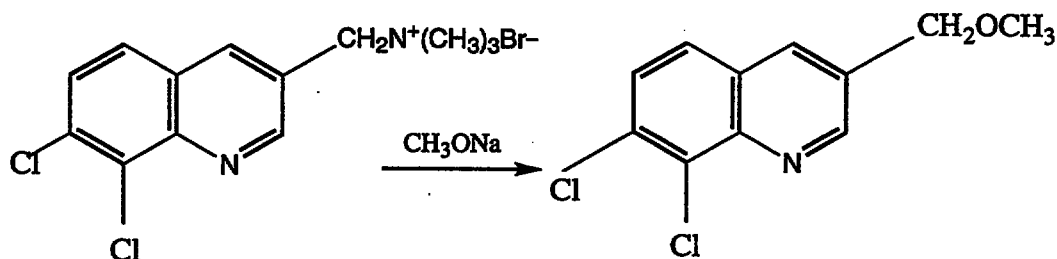


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A stirred mixture of 3-methyl-7,8-dichloroquinoline (106 g, 0.5 mol) in chlorobenzene (1000 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (89 g 0.5 mol), and 2,2'-azobisisobutyronitrile (3 g, 0.02 mol) is added to the reaction mixture over 30 minutes at 80-90°C. After the addition is complete, the reaction mixture is held a 80-90°C for 2 hours. The mixture is washed with water (400 mL) at 60-80°C and the organic mixture is diluted with acetone (300 mL). The mixture is cooled to 10°C and anhydrous trimethylamine (49 g, 0.83 mol) is added. The mixture is stirred overnight at 10-30°C and filtered to obtained a solid. The solid is washed with acetone and vacuum dried to give the title product as a white solid (129 g) which is identified by ¹H and ¹³C NMR spectral analyses.

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EXAMPLE 10: Preparation of 3-(Methoxymethyl)-7,8-dichloroquinoline



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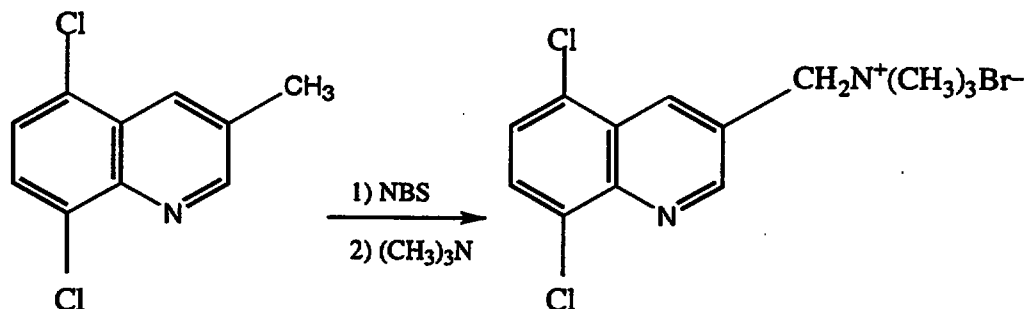
A mixture of 25% sodium methoxide (100g, 0.46 mol) in methanol (800 mL) and (7,8-dichloro-3-quinolyl) methyltrimethylammonium bromide (110 g, 0.31 mol) is heated under nitrogen at reflux for 2 hours and cooled to room temperature. The resulting mixture is diluted with ice water (800 mL) and filtered to obtained a solid. The solid is washed with water and vacuum dried to give the title product as an off-white solid (64.30 g,) which is identified by ¹H and ¹³C NMR spectral analyses.

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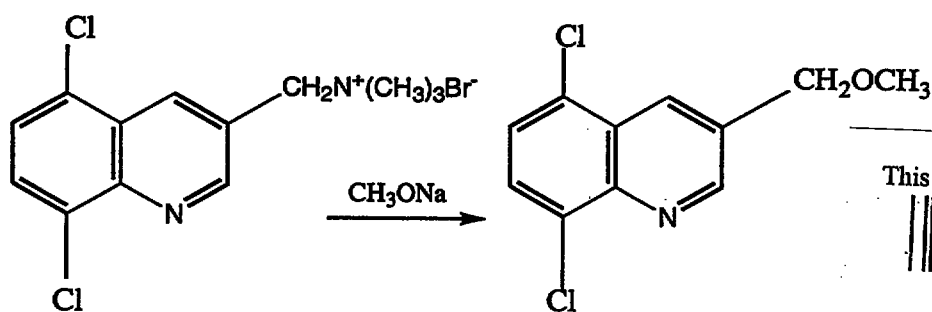
EXAMPLE 11: Preparation of (5,8-Dichloro-3-quinolyl)methyltrimethyl ammonium bromide



- 5 A stirred mixture of 3-methyl-5,8-dichloroquinoline (143 g, 0.67 mol) in chlorobenzene (1000 mL) is heated to 80°C under nitrogen. A mixture of N-bromosuccinimide (120 g, 0.67 mol), and 2,2'-azobisisobutyronitrile (5 g, 0.03 mol) is added to the reaction mixture over 30 minutes at 80-90°C. After the addition is complete, the reaction mixture is held at 80-90°C for 3 hours. The mixture is washed with water (600 mL) at 60-80°C and the organic mixture is diluted with acetone (200 mL). The mixture is cooled to 10°C and anhydrous trimethylamine (65g, 1.1 mol) is added. The mixture is stirred overnight at 10-30°C and filtered to obtain a solid. The solid is washed with acetone and vacuum dried to give the title product as a white solid (174.6 g, 90%) which is identified by ¹H and ¹³C NMR spectral analyses.

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EXAMPLE 12: Preparation of 3-(Methoxymethyl)-5,8-dichloroquinoline



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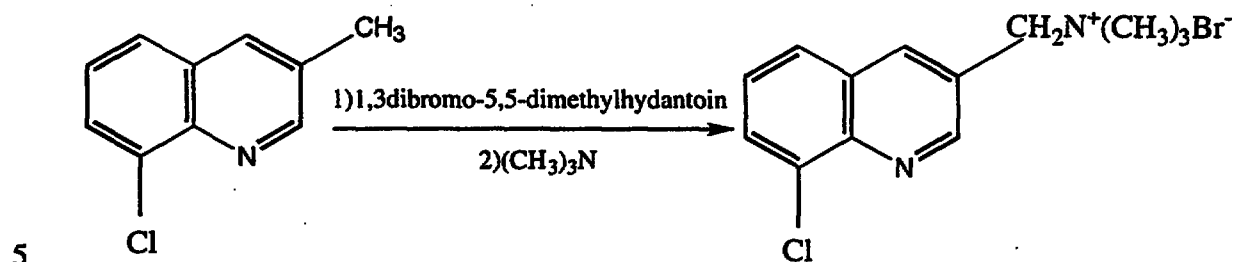
- A mixture of 25% sodium methoxide (130g, 0.6 mol) in methanol (800 mL) and (5,8-dichloro-3-quinolyl)methyltrimethylammonium bromide (146 g, 0.41 mol) is heated under nitrogen at reflux for 2 hours and cooled to room temperature. The resulting mixture is diluted with ice water (1200 mL) and filtered to obtain a solid. The solid is washed with water and vacuum dried to give the title product as a light-tan solid (91 g, 62%, mp 00-00°C) which is identified by ¹H and ¹³C NMR spectral analyses.

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EXAMPLE 13: Preparation of (8-Chloro-3-quinolyl) methyltrimethylammonium bromide using 1,3-dibromo-5,5-dimethylhydantoin



10 A stirred mixture of 3-methyl-8-chloroquinoline (71.2 g, 0.4 mol) in chlorobenzene (700 mL) is heated to 80°C under nitrogen. A mixture of 1,3 dibromo-5,5-dimethylhydantoin (57 g, 0.02 mol). and 2,2'-azobisisobutyronitrile (4 g, 0.024 mol) is added to the reaction mixture over 30 minutes at 80-90°C. After the addition is complete, the reaction mixture is held a 80-90°C for 1.5 hours. The mixture is washed twice with water (300 mL) at 60-80°C and the organic mixture is diluted with acetone (250 mL). The mixture is cooled to 10°C and anhydrous trimethylamine (36g, 0.6 mol) is added. The mixture is stirred at 10-30°C for 3 hours and filtered to obtained a solid. The solid is washed with acetone and vacuum dried to give the title product as off-white solid (34.1g) which is identified by ¹H and ¹³C.

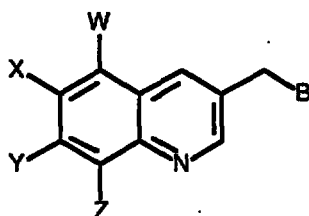
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**CLAIMS:**

1. A compound of the formula



wherein W, X and Y are independently H, halogen, NO₂, NH₂ or -O-alkyl straight or branched C₁-C₆; Z is H, halogen, NO₂, NH₂, OH or -O-alkyl straight or branched C₁-C₆ and B is chlorine, bromine, a quaternary ammonium halide or -O-alkyl straight or branched C₁-C₆;

with the proviso that when the following values of B, W, X, and Y are taken simultaneously: B is -O-alkyl straight or branched C₁-C₆; W is H; X is H and Y is H, then Z is not OH or -O-alkyl straight or branched C₁-C₆.

2. A compound according to claim 1 wherein W, X and Y are each H, Z is chlorine and B is bromine, trimethyl ammonium bromide or methoxy.
3. A compound according to claim 1 wherein W, X and Y are each H, Z is NO₂ and B is bromine, trimethyl ammonium bromide or methoxy.
4. A compound according to claim 1 wherein W, X and Y are each H, Z is NH₂ and methoxy.
5. A compound according to claim 1 wherein X and Y are H, W is NO₂, Z is chlorine and B is -O-CH₃.
6. A compound according to claim 1 wherein X and W are H, Y and Z are chlorine and B is trimethylammonium bromide.
7. A compound according to claim 1 wherein X and W are H, Y and Z are chlorine and B is -OCH₃.

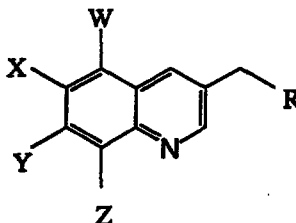
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8. A compound according to claim 1 wherein X and Y are H, W and Z are chlorine and B is -OCH₃ or trimethylammonium bromide.

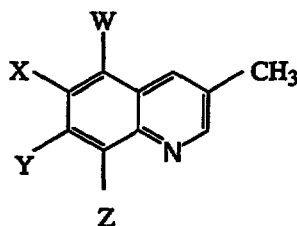
9. A process for preparing a compound of the formula



wherein W, X and Y are independently H, halogen, NO₂, NH₂ or -O-alkyl straight or branched C₁-C₆; Z is H, halogen, NO₂, NH₂, OH or -O-alkyl straight or branched C₁-C₆ and B is chlorine, bromine, a quaternary ammonium halide or -O-alkyl straight or branched C₁-C₆;

with the proviso that when the following values of B, W, X, and Y are taken simultaneously: B is -O-alkyl straight or branched C₁-C₆; W is H; X is H and Y is H, then Z is not OH or -O-alkyl straight or branched C₁-C₆, which comprises

(a) reacting a compound of the formula II



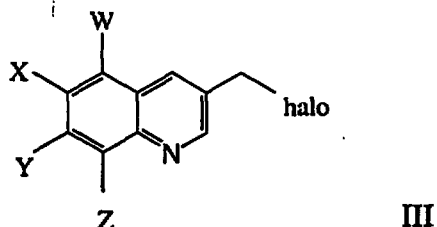
II

wherein W, X, Y and Z are independently H, halogen, NO₂, -O-alkyl straight or branched C₁-C₆ with a radical halogenating reagent wherein the halogen is bromine or chlorine to form a compound of the formula III wherein halo is chlorine or bromine

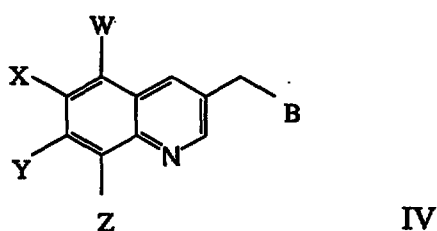
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(b) reacting compound III with a tertiary amine to form a compound of the formula IV



wherein B is a tertiary ammonium halide; and

(c) reacting compound IV with ROM wherein R is alkyl straight or branched C₁-C₆ and M is Na, Li or K to form the compound of formula I and

(d) if desired converting the compound of formula I or protected amino derivative thereof obtained to a further compound of formula I.

10. A process according to claim 9 wherein ROM is sodium methoxide.

11. A process according to claim 9 wherein the radical halogenating agent to form compound III is N-bromosuccinimide or 1,3-dibromo-5,5-dimethylhydantoin and the tertiary amine to form compound IV is trimethyl amine.

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