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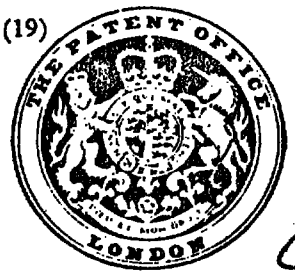
# PATENT SPECIFICATION

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## (54) PHARMACEUTICAL COMPOSITIONS

(71) We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, Imperial Chemical House, Millbank, London, SW1P 3JF, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pharmaceutical composition which may be administered parenterally to a warm-blooded animal for the production of general anaesthesia.

According to the invention there is provided a sterile pharmaceutical composition which comprises the compound 2,6-diisopropylphenol in association with a sterile pharmaceutically-acceptable diluent or carrier, the composition being suitable either directly or after dilution with a liquid diluent for parenteral administration to a warm-blooded animal.

The compound 2,6-diisopropylphenol is a known compound and may be obtained and purified by known means. It is liquid at laboratory temperature (m.p. 18°C.).

The composition of the invention is preferably an aqueous composition which comprises the compound 2,6 - diisopropylphenol in sterile admixture with water and a surfactant or other solubilising agent, and may optionally contain one or more additional solvents.

Alternatively, the composition of the invention may be an aqueous composition which comprises the compound 2,6-diisopropylphenol in sterile admixture with water and an additional water-miscible, non-aqueous solvent, the proportions of which are such that a homogeneous composition is obtained.

Yet alternatively the composition of the invention may be a liquid non-aqueous composition which comprises a sterile solution of the compound 2,6 - diisopropylphenol in a suitable water-miscible, non-aqueous solvent, which solution may optionally contain a surfactant. Such a composition may be used directly for parenteral administration, especially to non-human animals, or it may be a concentrated solution suitable for dilution with sterile water, optionally containing a surfactant, the sterile diluted aqueous composition then being of the type described in either of the two preceding paragraphs.

Yet alternatively the composition of the invention may comprise a sterile solid or semi-solid mixture of 2,6-diisopropylphenol with a solid diluent, for example lactose, saccharin sodium or a cyclodextran, which composition is suitable for dilution with a sterile aqueous diluent to form a composition of the type described in either of the two paragraphs preceding the last paragraph above.

Yet alternatively the composition of the invention may comprise an oil-in-water emulsion in which the 2,6-diisopropylphenol, either alone or dissolved in a water-immiscible solvent, for example a vegetable oil, for example arachis oil, or an ester of a fatty acid, for example ethyl oleate, is emulsified with water by means of a surfactant.

A suitable surfactant is, for example, a non-ionic surfactant, for example a condensation product of ethylene oxide with a fatty acid, for example a polyoxyethylene laurate, stearate or oleate, for example such a surfactant known under the Trade Mark 'Myrj'; or a condensation product of ethylene oxide with a vegetable oil, for example castor oil, or a derivative thereof, for example such a surfactant known under the Trade Mark 'Cremophor', 'Micelliphor', 'Texofor' D, 'Emulphor' (or 'Mulgofen'); or a condensation product of ethylene oxide with an aliphatic alcohol of 12 to 18 carbon atoms, for example a polyoxyethylene cetyl, lauryl, stearyl or oleyl ether, for example such a surfactant known under the Trade Mark 'Brij'; or a condensation product of ethylene oxide with a partial ester derived from a fatty acid and a hexitol anhydride, for example a polyoxyethylene sorbitan monolaurate, monopalmitate, monostearate or monooleate, for example such a surfactant known under the Trade Mark 'Tween'; or

a polyoxyethylene - polyoxypropylene block copolymer, for example such a surfactant known under the Trade Mark 'Pluronic'.

Particular surfactants of the above types which may be used in a composition of the invention are those known under the Trade Mark 'Tween' 20, 40, 60 or 80; 'Myrj' 52 or 53; 'Brij' 35; 'Pluronic' F68; 'Emulphor' (or 'Mulgofen') EL 620 or EL 719; 'Texopor' D40 or G80; 'Cremophor' EL RH40 or RH60 or 'Micelliphor', and of these a preferred surfactant is 'Cremophor' EL, 'Cremophor' RH40, 'Micelliphor' or 'Pluronic' F68.

Other surfactants which may be used in a composition of the invention, especially if the composition is of an emulsion type, are naturally - occurring phosphatides, for example lecithin, or esters of a hexitol anhydride and a fatty acid, for example a sorbitan monolaurate, monopalmitate, monostearate or monooleate, for example such a surfactant known under the Trade Mark 'Span'.

A suitable solubilising agent other than a surfactant is, for example, polyvinylpyrrolidone, saccharin sodium or a cyclodextran.

A suitable additional solvent in an aqueous composition of the invention, or a suitable non-aqueous solvent which may be used in a liquid non-aqueous composition of the invention is, for example, an alcohol, for example ethanol; a glycol, for example propylene glycol, hexylene glycol or a polyethylene glycol, for example a polyethylene glycol of molecular weight approximately 200, 400 or 600; or a glycol monoether, for example ethylene glycol monoethyl ether; or a water-miscible ester or amide, for example γ-butyrolactone, ethyl lactate, *N*-methylformamide, *N*,*N* - dimethylacetamide, N - β-hydroxyethyllactamide or *N*,*N*,*N*',*N*'-tetramethylurea. A preferred solvent is ethanol, propylene glycol or a polyethylene glycol of molecular weight approximately 200, 400 or 600.

A preferred aqueous composition of the invention comprises from 0.1 to 5% by weight, especially from 1 to 2% by weight, and particularly 2% by weight, of 2,6-diisopropylphenol; from 2 to 30% by weight, especially from 10 to 20% by weight, of a non-ionic surfactant, and optionally from 2 to 30% by weight of an alcohol or glycol additional solvent, the rest of the composition being water.

A preferred composition of the invention which does not contain a surfactant comprises from 0.1 to 20% by weight, especially from 1 to 2% by weight, and particularly 2% by weight, of 2,6-diisopropylphenol; and rrom 10 to 99.9% by weight, especially 40 to 98% by weight, of a water-miscible solvent, the rest of the composition, if any, being water.

When an alternative solubilising agent is used, this will be present in the composition in the range, for example, of from 20 to 40% by weight of polyvinylpyrrolidone, from 2 to 20% by weight of saccharin sodium or from 0.2 to 10% by weight of a cyclodextran.

The composition of the invention may optionally contain one or more additional constituents selected from stabilisers, preservatives and antioxidants, for example parabens derivatives, for example propyl *p*-hydroxybenzoate, butylated hydroxytoluene derivatives, ascorbic acid and sodium metabisulphite; metal ion sequestering agents, for example sodium edetate; and antifoaming agents, for example a silicone derivative, for example dimethicone or simethicone. The composition of the invention may also contain another anaesthetic agent.

An aqueous composition of the invention is preferably adjusted to a pH of from 4 to 10, especially from 5 to 7, and it may contain buffering agents, for example citric acid and sodium citrate, to maintain the pH value.

The composition of the invention may be made isotonic with blood by the incorporation of the required amount of a suitable inorganic salt, for example from 0.1 to 0.9% by weight sodium chloride, or of a sugar or sugar derivative, for example dextrose. Furthermore, a suitable sterile aqueous saline or dextrose solution may be used in place of sterile water wherever such water is hereinbefore or hereinafter mentioned.

A particularly preferred composition of the invention comprises a sterile aqueous composition containing from 1 to 5% by weight, especially from 1 to 2% by weight and particularly 2% by weight of 2,6 - diisopropylphenol; from 10 to 20% by weight of a polyoxyethylene castor oil derivative, especially 'Cremophor' EL, 'Cremophor' RH40 or 'Micelliphor' or of a polyoxyethylene-polyoxypropylene block copolymer, especially 'Pluronic' F68; and optionally from 5 to 20% by weight of ethanol, propylene glycol or a polyethylene glycol, the rest of the composition being water or a suitable saline or dextrose solution. This composition will preferably be buffered to a pH of from 5 to 7.

The composition may be sterilised by conventional techniques, for example by heat or irradiation, or by filtration through a bacterial filter, for example a cellulose ester membrane of pore size no greater than 0.22 μ.

The compound 2,6-diisopropylphenol produces smooth and rapid anaesthesia when injected intravenously as a composition of the invention into mice, rats, rabbits, cats, rhesus or pigtail monkeys, pigs, sheep, horses or cattle at a single dose of from 2.5 to

10 mg. per kg. bodyweight. Anaesthesia is produced in less than 1 minute and lasts, depending upon the species and the dose, from 3 to 25 minutes. Recovery of all animals is normal and rapid, depending upon the species and the dose taking from 7 to 45 minutes from induction, and no adverse side-effects are noted at anaesthetic doses. The $HD_{50}$ dose of the compound in mice is 13.5 mg. per kg. bodyweight and the $LD_{50}$ dose in mice is 56 mg./kg. bodyweight. The compound may also be administered intramuscularly.

The composition of the invention may be used for the induction of anaesthesia prior to maintenance with a conventional inhalation anaesthetic, or it may be used as a sole anaesthetic agent of short duration, or by repeated administration or by continuous infusion it may be used as a sole anaesthetic agent of longer duration.

When used for inducing anaesthesia in an adult human it is expected that a composition of the invention will be administered such that from 5 to 10 ml. of a composition containing from 1 to 5% by weight, preferably 2% by weight, of 2,6-diisopropylphenol is administered during 15 to 30 seconds. When used in children, a composition containing 1% by weight of 2,6-diisopropylphenol is preferred.

A composition of the invention will usually be provided for use in a warm-blooded animal in unit dosage form, preferably in a sealed ampoule containing from 5 to 10 ml. of a liquid composition. The ampoule may contain the liquid under an atmosphere of nitrogen, and the contents of the ampoule may be made sterile either by bacterial filtration followed by use of an aseptic filling technique, or by heat treatment of the ampoule after sealing.

The invention is illustrated but not limited by the following Examples:—

Example 1

Distilled water is added to a solution of 2,6-diisopropylphenol (20 g.) in a polyoxyethylated ricinoleic acid (100 g. of 'Cremophor' EL) until a volume of 1 litre is obtained. The solution is filled into ampoules which are then sealed and sterilised by heating in a steam autoclave. There is thus obtained a sterile solution suitable for administration parenterally to a warm-blooded animal.

Example 2

Distilled water (90 ml.) is added slowly to a well-stirred solution of 2,6-diisopropylphenol (2 g.) in 'Cremophor' EL (10 g.). The resulting micro-emulsion is passed through a bacterial filter and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that there is incorporated into the mixture either

(i) sodium edetate (0.0.2 g.); or
(ii) citric acid (0.1 g.); or
(iii) propyl *p*-hydroxybenzoate ('Nipasol' M, 0.01 g.; 'Nipasol' is a Trade Mark); or
(iv) 2,6 - di - t - butyl - 4 - methylphenol ('Topanol' BHT, 0.01 g.; 'Topanol' is a Trade Mark).

In each case there is obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 3

80 Ml. of a solution of sodium chloride (0.9 g.) and sodium edetate (0.02 g.) in distilled water (100 ml.) are added slowly to a well-stirred solution of 2,6 - diisopropylphenol (2 g.) in a mixture of 'Cremophor' EL (10 g.) and ethanol (10 ml.). The micro-emulsion thus obtained is passed through a bacterial filter, and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that citric acid (0.1 g.) is used in place of the sodium edetate. There is similarly obtained a sterile micro-emulsion suitable for parenteral administration to a warm-blooded animal.

Example 4

Distilled water (80 ml.) is added slowly to a well-stirred solution of 2,6-diisopropylphenol (2 g.) in a mixture of 'Cremophor' EL (10 g.) and γ-butyrolactone (10 g.). The resulting micro-emulsion is passed through a bacterial filter and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 5

Distilled water (900 ml.) is added slowly to a well-stirred solution of 2,6-diisopropylphenol (10 g.) in polyoxyethylene (20) sorbitan monooleate ('Tween' 80, 100 g.; 'Tween' is a Trade Mark). The resulting micro-emulsion is passed through a bacterial filter and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 6

Distilled water (90 ml.) is added to a solution of 2,6-diisopropylphenol (2 g.) in polyoxyethylene (20) sorbitan monopalmitate ('Tween' 40, 10 g.). The emulsion thus obtained is repeatedly passed through a homogeniser until the particle size of the

emulsion is reduced to an average of 5 microns, and the resulting micro-emulsion is sterilised by heating in an autoclave. There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that the 'Tween' 40 is replaced by an equal amount of polyoxyethylene (20) sorbitan monostearate ('Tween' 60). There is thus similarly obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that the ingredients used are:—

(a) 2,6-diisopropylphenol (1 g.)
polyoxyethylene monostearate ('Myrj' 52) (5 g.)
distilled water (95 ml.)
or
(b) 2,6-diisopropylphenol (10 g.)
polyoxyethylene monostearate ('Myrj' 53) (100 g.)
distilled water (900 ml.).

'Cremophor' RH40 (200 g.)
'Micelliphor' (200 g.)
'Cremophor' RH60 (200 g.)
} (polyoxyethylated castor oil derivatives)
'Mulgofen' EL 719 (200 g.) (a polyoxyethylated vegetable oil)
'Tween' 40 (200 g.)
'Tween' 80 (200 g.)

The resulting solution is sterilised by the procedure described in either Example 1 or Example 2 and there is thus obtained a sterile solution suitable for parenteral administration to a warm-blooded animal.

Example 9

A stirred mixture of 2,6-diisopropylphenol (2 g.), polyethylene glycol 200 (10 g.) and 'Cremophor' RH40 (10 g.) is gently heated until a homogeneous mixture is obtained. Water for injection (78 g.) is added portionwise, and the resulting clear solution is sterilised by passage through a bacterial filter (cellulose ester membrane, pore size 0.22 $\mu$.). There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated using the following ingredients:—

(a) 2,6-diisopropylphenol (2 g.)
ethanol (5 g.)
'Cremophor' EL (10 g.)
water (to 100 g.)

(b) 2,6-diisopropylphenol (2 g.)
propylene glycol (10 g.)
'Cremophor' EL (10 g.)
water (to 100 g.)

There is similarly obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 7

Distilled water (80 ml.) is added to a stirred mixture of 2,6-diisopropylphenol (2 g.), 'Cremophor' EL (1 g.), 'Tween' 80 (1 g.) and arachis oil (20 ml.). The resulting emulsion is repeatedly passed through a homogeniser until a suitably low particle size is formed, and is then sterilised by heating in an autoclave. There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 8

The process described in Example 1 is repeated except that the 100 g. of 'Cremophor' EL are replaced by the indicated amount of one of the following surfactants:—

(c) 2,6-diisopropylphenol (2 g.)
polyethylene glycol 400 (10 g.)
'Cremophor' EL (10 g.)
water (to 100 g.)

(d) 2,6-diisopropylphenol (2 g.)
polyethylene glycol 600 (10 g.)
'Cremophor' EL (10 g.)
water (to 100 g.)

(e) 2,6-diisopropylphenol (2 g.)
ethanol (5 g.)
'Cremophor' RH40 (20 g.)
water (to 100 g.)

(f) 2,6-diisopropylphenol (2g.)
propylene glycol (10 g.)
'Cremophor' RH40 (20 g.)
water (to 100 g.)

(g) 2,6-diisopropylphenol (2 g.)
polyethylene glycol 200 (10 g.)
'Cremophor' RH40 (20 g.)
water (to 100 g.)

(h) 2,6-diisopropylphenol (2 g.)
ethanol (10 g.)
'Tween' 60 (10 g.)
water (to 100 g.)

(i) 2,6-diisopropylphenol (2 g.)
ethanol (8 g.)
'Tween' 20 (polyoxyethylene (20) sorbitan monolaurate) (15 g.)
water (to 100 g.)

There are thus similarly obtained sterile compositions suitable for parenteral administration to a warm-blooded animal.

Example 10

A solution of 2,6-diisopropylphenol (2 g.) in ethanol (10 g.) is added to a stirred solution of polyoxyethylene (23) lauryl ether ('Brij' 35) (20 g.) in water for injection (20 g.), and further water for injection (48 g.) is then added. The mixture thus obtained is sterilised by heating in a steam autoclave at 115°C. for 30 minutes, and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that there are used as ingredients:—

(a) 2,6-diisopropylphenol (2 g.)
propylene glycol (10 g.)
polyoxyethylene - polyoxypropylene block copolymer
'Pluronic' F68 (10 g.)
water (to 100 g.)

(b) 2,6-diisopropylphenol (2 g.)
ethanol (20 g.)
polyvinylpyrrolidone ('Plasdone' C 15) (30 g.)
water for injection (to 100 g.)

There are thus similarly obtained sterile compositions suitable for parenteral administration to a warm-blooded animal.

Example 11

Water for injection is added slowly to a stirred solution of 2,6-diisopropylphenol (2 g.) in ethanol (40 g.) until the total weight of the mixture is 100 g. The mixture is then sterilised by passage through a bacterial filter and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that the 40 g. of ethanol is replaced by 70 g. of either propylene glycol, polyethylene glycol 200, polyethylene glycol 400 or polyethylene glycol 600. There are thus similarly obtained sterile compositions suitable for parenteral administration to a warm-blooded animal.

Example 12

2,6-Diisopropylphenol (2 g.) is added to a stirred solution of saccharin sodium (5 g.) in water for injection (93 g.). The solution thus obtained is sterilised by passage through a bacterial filter and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that a cyclodextran (Schardinger α-dextrin) (4 g.) is used in place of the 5 g. of saccharin sodium. There is thus similarly obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 13

A mixture of 2,6-diisopropylphenol (2 g.) propylene glycol (10 g.) and 'Cremophor' EL (10 g.) is warmed until a clear solution is obtained. The solution is sterilised by passage through a bacterial filter and there is thus obtained a concentrated sterile solution suitable for dilution with sterile water in order to form a sterile composition suitable for parenteral administration to a warm-blooded animal.

The process described above is repeated except that there is also incorporated a silicone antifoaming agent (0.001 g.). There is thus similarly obtained a concentrated sterile solution suitable for dilution as stated above.

Example 14

The process described in Example 1 is repeated except that the distilled water is replaced by an equal volume of 0.9% w/v aqueous sodium chloride solution ("physiological saline"). There is thus obtained a 2% sterile solution suitable for parenteral administration to a warm-blooded animal.

The 2% sterile solution described above is diluted with an equal volume of "physiological saline". There is thus obtained a 1% sterile solution suitable for parenteral administration to a warm-blooded animal.

Example 15

Each mouse in various groups of 10 mice is injected intravenously with a 1% sterile solution of 2,6-diisopropylphenol as described in Example 14, the total dose administered being the same within any group but differing between groups. The dose ($HD_{50}$) required to cause anaesthesia (loss of righting reflex for at least 30 seconds) in 5 out of 10 mice, and the dose ($LD_{50}$) required to kill 5 out of 10 mice, are then determined to be 13.5 mg./kg. bodyweight and 56 mg./kg. bodyweight respectively. The therapeutic ratio ($LD_{50}/HD_{50}$) is therefore 4.14.

Each of 10 mice is injected intravenously with 27 mg./kg. bodyweight (twice the $HD_{50}$) of 2,6-diisopropylphenol as a 1% sterile solution described in Example 14. The mean sleeping time of a mouse is 4.29 minutes (standard deviation ±0.59 minutes).

For comparison, under similar conditions using the known anaesthetic agent thiopen-

tone sodium, the corresponding figures are:—

| | |
|---|---|
| $HD_{50}$ | 23.5 mg./kg. bodyweight |
| $LD_{50}$ | 100 mg./kg. bodyweight |
| Therapeutic ratio | 4.26 |
| Mean sleeping time after twice the $HD_{50}$ | $5.97 \pm 1.63$ minutes |

Example 16

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is administered intravenously to a pigtail monkey weighing 6.8 kg. at a rate of 0.05 mg. of phenol/kg. bodyweight/second until a dose of 34 mg. (5 mg./kg. bodyweight) of the phenol has been injected. Induction of anaesthesia is smooth and rapid, muscle relaxation is produce, spinal reflexes are depressed and anaesthesia lasts for approximately 6 minutes. Recovery after this period is rapid and is almost complete 16 minutes after induction.

Example 17

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is administered intravenously to each cat in a group of 5 cats, at a rate of 0.05 mg. of phenol/kg. bodyweight/second, until each cat has received a dose of 10 mg. of phenol/kg. bodyweight. Induction of anaesthesia is rapid and free from excitement, muscle relaxation is produced and spinal reflexes are depressed. Response to painful stimulation returns after approximately 10 minutes, and further recover is smooth and rapid. Righting reflexes reappear after a mean time of 34 minutes (standard deviation $\pm 7.35$ minutes) from induction and the cat is able to stand again after a mean time of 42.6 minutes ($\pm 10.29$ minutes) after induction.

Example 18

A cat weighing 2.5 kg. is anaesthetised exactly as described in Example 17. A laparotomy operation is then begun which lasts for 45 minutes, and anaesthesia is maintained during that time by four supplementary intravenous injections each of 2.0 mg. of phenol/kg. bodyweight administered as a 2% sterile solution. After the operation recovery is rapid and the cat is able to stand 35 minutes after completion of the operation.

Example 19

A cat is anaesthetised exactly as described in Example 17. Anaesthesia is produced of sufficient depth to allow intubation of the trachea following the application of a topical anaesthetic to the larynx. Anaesthesia is thereafter maintained with an inhalation anaesthetic delivered through an Ayre's T-piece circuit.

Example 20

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is injected intramuscularly into a cat at a dose of 35 mg. of phenol/kg. bodyweight. Righting reflexes are lost after 15 minutes, and after a further 25 minutes anaesthesia has deepened sufficiently to allow intubation to be carried out. Muscle tone returns after a further 60 minutes and thereafter recovery is uneventful. No pain or lesion at the site of injection is observed during the subsequent 7 days.

Example 21

Distilled water is added to a solution of 2,6-diisopropylphenol (20 g.) in a polyoxyethylated castor oil ('Texofor' D40) (150 g.) until a volume of 1 litre is obtained. The solution is filled into ampoules each containing 10 ml. of solution, and the ampoules are sealed and sterilised by heating in a steam autoclave at 115°C. for 30 minutes. There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 22

The process described in Example 21 is repeated except that there are used as ingredients:—

2,6-diisopropylphenol (20 g.)
'Cremophor' RH40 (140 g.)
distilled water (to 1 litre)

Sufficient sodium chloride is added to make the solution isotonic with blood, and the pH of the solution is adjusted to 6 with citric acid. The solution is filled into ampoules and sterilised as described in Example 21, and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 23

The process described in Example 9 is repeated except that there are used as ingredients:—

2,6-diisopropylphenol(2 g.)
ethanol (10 g.)
'Cremophor' RH40 (10 g.)
water (to 100 g.)

There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

WHAT WE CLAIM IS:—

1. A sterile pharmaceutical composition which comprises the compound 2,6-diisopropylphenol in association with a sterile pharmaceutically-acceptable diluent or carrier the composition being suitable either directly or after dilution with a liquid diluent for

tone sodium, the corresponding figures are:—

| | |
|---|---|
| $HD_{50}$ | 23.5 mg./kg. bodyweight |
| $I.D_{50}$ | 100 mg./kg. bodyweight |
| Therapeutic ratio | 4.26 |
| Mean sleeping time after twice the $HD_{50}$ | 5.97 ± 1.63 minutes |

Example 16

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is administered intravenously to a pigtail monkey weighing 6.8 kg. at a rate of 0.05 mg. of phenol/kg. bodyweight/second until a dose of 34 mg. (5 mg./kg. bodyweight) of the phenol has been injected. Induction of anaesthesia is smooth and rapid, muscle relaxation is produce, spinal reflexes are depressed and anaesthesia lasts for approximately 6 minutes. Recovery after this period is rapid and is almost complete 16 minutes after induction.

Example 17

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is administered intravenously to each cat in a group of 5 cats, at a rate of 0.05 mg. of phenol/kg. bodyweight/second, until each cat has received a dose of 10 mg. of phenol/kg. bodyweight. Induction of anaesthesia is rapid and free from excitement, muscle relaxation is produced and spinal reflexes are depressed. Response to painful stimulation returns after approximately 10 minutes, and further recover is smooth and rapid. Righting reflexes reappear after a mean time of 34 minutes (standard deviation +7.35 minutes) from induction and the cat is able to stand again after a mean time of 42.6 minutes (+10.29 minutes) after induction.

Example 18

A cat weighing 2.5 kg. is anaesthetised exactly as described in Example 17. A laparotomy operation is then begun which lasts for 45 minutes, and anaesthesia is maintained during that time by four supplementary intravenous injections each of 2.0 mg. of phenol/kg. bodyweight administered as a 2% sterile solution. After the operation recovery is rapid and the cat is able to stand 35 minutes after completion of the operation.

Example 19

A cat is anaesthetised exactly as described in Example 17. Anaesthesia is produced of sufficient depth to allow intubation of the trachea following the application of a topical anaesthetic to the larynx. Anaesthesia is thereafter maintained with an inhalation anaesthetic delivered through an Ayre's T-piece circuit.

Example 20

A 2% sterile solution of 2,6-diisopropylphenol prepared as described in Example 14 is injected intramuscularly into a cat at a dose of 35 mg. of phenol/kg. bodyweight. Righting reflexes are lost after 15 minutes, and after a further 25 minutes anaesthesia has deepened sufficiently to allow intubation to be carried out. Muscle tone returns after a further 60 minutes and thereafter recovery is uneventful. No pain or lesion at the site of injection is observed during the subsequent 7 days.

Example 21

Distilled water is added to a solution of 2,6-diisopropylphenol (20 g.) in a polyoxyethylated castor oil ('Texofor' D40) (150 g.) until a volume of 1 litre is obtained. The solution is filled into ampoules each containing 10 ml. of solution, and the ampoules are sealed and sterilised by heating in a steam autoclave at 115°C. for 30 minutes. There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 22

The process described in Example 21 is repeated except that there are used as ingredients:—

2,6-diisopropylphenol (20 g.)
'Cremophor' RH40 (140 g.)
distilled water (to 1 litre)

Sufficient sodium chloride is added to make the solution isotonic with blood, and the pH of the solution is adjusted to 6 with citric acid. The solution is filled into ampoules and sterilised as described in Example 21, and there is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

Example 23

The process described in Example 9 is repeated except that there are used as ingredients:—

2,6-diisopropylphenol(2 g.)
ethanol (10 g.)
'Cremophor' RH40 (10 g.)
water (to 100 g.)

There is thus obtained a sterile composition suitable for parenteral administration to a warm-blooded animal.

WHAT WE CLAIM IS:—

1. A sterile pharmaceutical composition which comprises the compound 2,6-diisopropylphenol in association with a sterile pharmaceutically-acceptable diluent or carrier the composition being suitable either directly or after dilution with a liquid diluent for

parenteral administration to a warm-blooded animal.

2. A composition as claimed in claim 1 which is an aqueous composition which comprises the compound 2,6-diisopropylphenol in sterile admixture with water and a surfactant or other solubilising agent, and which may optionally contain one or more additional solvents.

3. A composition as claimed in claim 1 which is an aqueous composition which comprises the compound 2,6-diisopropylphenol in sterile admixture with water and an additional water-miscible, non-aqueous solvent, the proportions of which are such that a homogeneous composition is obtained.

4. A composition as claimed in claim 1 which is a liquid non-aqueous composition which comprises a sterile solution of the compound 2,6-diisopropylphenol in a water-miscible, non-aqueous solvent, which solution may optionally contain a surfactant.

5. A composition as claimed in claim 1 which comprises a sterile solid or semi-solid mixture of 2,6-diisopropylphenyl with a solid diluent.

6. A composition as claimed in claim 1 which comprises an oil-in-water emulsion in which the 2,6-diisopropylphenol, either alone or dissolved in a water-immiscible solvent, is emulsified with water by means of a surfactant.

7. A composition as claimed in any of claims 1, 2, 4 or 6 in which the surfactant is a non-ionic surfactant.

8. A composition as claimed in claim 7 in which the surfactant is a condensation product of ethylene oxide with a fatty acid, or a condensation product of ethylene oxide with a vegetable oil or a derivative thereof, or a condensation product of ethylene oxide with an aliphatic alcohol of 12 to 18 carbon atoms, or a condensation product of ethylene oxide with a partial ester derived from a fatty acid and a hexitol anhydride, or a polyoxyethylene-polyoxypropylene block copolymer.

9. A composition as claimed in claim 8 in which the surfactant is a polyoxyethylene laurate, stearate or oleate, or a polyoxyethylene vegetable oil derivative, or a polyoxyethylene cetyl, lauryl, stearyl or oleyl ether, or a polyoxyethylene sorbitan monolaurate, monopalmitate, monostearate or monooleate, or a polyoxyethylene - polyoxypropylene block copolymer.

10. A composition as claimed in claim 9 in which the surfactant is one known under the Trade Mark 'Tween' 20, 40, 60 or 80; 'Myrj' 52 or 53; 'Brij' 35; 'Pluronic' F68; 'Emulphor' (or 'Mulgofen') EL 620 or EL 719; 'Texophor' D40 or D80; 'Cremophor' EL, RH40 or RH60 or 'Micelliphor'.

11. A composition as claimed in claim 10 in which the surfactant is one known under the Trade Mark 'Cremophor' EL, 'Cremophor' RH40, 'Micelliphor' or 'Pluronic' F68.

12. A composition as claimed in claim 1 or 6 in which the surfactant is a naturally-occurring phosphatide, or an ester of a hexitol anhydride and a fatty acid.

13. A composition as claimed in claim 12 in which the surfactant is a lecithin or a sorbitan monolaurate, monopalmitate, monostearate or monooleate.

14. A composition as claimed in claim 1, 2 or 6 in which the solubilising agent other than a surfactant is polyvinyl - pyrrolidone, saccharin sodium or a cyclodextran.

15. A composition as claimed in any of claims 1 to 4, 7 to 11 and 14 in which the additional solvent in an aqueous composition, or the non-aqueous solvent in a liquid non-aqueous composition is an alcohol, a glycol, a glycol monoether or a water-miscible ester or amide.

16. A composition as claimed in claim 15 in which the solvent is ethanol, propylene glycol, hexylene glycol, a polyethylene glycol, ethylene glycol monoethyl ether, $\gamma$-butyrolactone, ethyl lactate, *N*-methylformamide, *N,N* - dimethylacetamide, *N* - $\beta$ - hydroxyethyllactamide or *N,N,N',N'* - tetramethylurea.

17. A composition as claimed in claim 16 in which the solvent is ethanol, propylene glycol or a polyethylene glycol of molecular weight approximately 200, 400 or 600.

18. A composition as claimed in claim 5 in which the solid diluent is lactose, saccharin sodium or a cyclodextran.

19. A composition as claimed in claim 6 in which the water-immiscible solvent is a vegetable oil or an ester of a fatty acid.

20. A composition as claimed in claim 19 in which the solvent is arachis oil or ethyl oleate.

21. A composition as claimed in claim 1 or 2 which comprises from 0.1 to 5% by weight of 2,6-diisopropylphenol; from 2 to 30% by weight of a non-ionic surfactant, and optionally from 2 to 30% by weight of an alcohol or glycol additional solvent, the rest of the composition being water.

22. A composition as claimed in claim 21 which contains from 10 to 20% by weight of a non-ionic surfactant.

23. A composition as claimed in claim 1, 3 or 4 which comprises from 0.1 to 20% by weight of 2,6 - diisopropylphenol and from 10 to 99.9% by weight of a water-miscible solvent, the rest ofthe composition, if any, being water.

24. A composition as claimed in claim 23 which contains from 40 to 98% by weight of a water-miscible solvent.

25. A composition as claimed in any of claims 21 to 24 which contains from 1 to 2% by weight of 2,6 - diisopropylphenol.

26. A composition as claimed in claim

25 which contains 2% by weight of 2,6-diisopropylphenol.

27. A composition as claimed in claim 14 which contains from 20 to 40% by weight of polyvinylpyrrolidone, from 2 to 20% by weight of saccharin sodium or from 0.2 to 10% by weight of a cyclodextran.

28. A composition as claimed in any of claims 1 to 27 which contains one or more additional constituents selected from stabilisers, preservatives, antioxidants, metal ion sequestering agents and antifoaming agents.

29. A composition as claimed in any of claims 1 to 28 which also contains another anaesthetic agent.

30. An aqueous composition as claimed in any of claims 1 to 3, 6 to 17 and 19 to 29 wherein the pH is between 4 and 10.

31. A composition as claimed in claim 30 wherein the pH is between 5 and 7.

32. A composition as claimed in claim 30 or 31 which contains a buffering agent to maintain the pH value.

33. A composition as claimed in any of claims 1 to 3, 6 to 17 and 19 to 33 which is made isotonic with blood.

34. A composition as claimed in claim 33 which is made isotonic with blood by incorporation of the required amount of sodium chloride or dextrose.

35. A composition as claimed in claim 1 which comprises a sterile aqueous composition containing from 1 to 5% by weight of 2,6 - diisopropylphenol, from 10 to 20% by weight of a polyoxyethylene castor oil derivative, or of a polyoxyethylene - polypropylene block copolymer, and optionally from 5 to 20% by weight of ethanol, propylene glycol or a polyethylene glycol, the rest of the composition being water or a suitable saline or dextrose solution.

36. A composition as claimed in claim 35 which contains from 1 to 2% by weight of 2,6-diisopropylphenol.

37. A composition as claimed in claim 36 which contains 2% by weight of 2,6-diisopropylphenol.

38. A composition as claimed in any of claims 35 to 37 which is buffered to a pH of between about 5 and 7.

39. A composition as claimed in any of claims 1 to 38 which is sterilised by heat or irradiation, or by filtration through a bacterial filter.

40. An ampoule containing from 5 to 10 ml. of a sterile liquid composition claimed in any of claims 1 to 4, 6 to 17 and 9 to 39.

41. An ampoule containing from 5 to 10 ml. of a sterile liquid composition claimed in any of claims 25, 26, 36 and 37.

42. A method for producing anaesthesia in a warm-blooded animal which comprises administering parenterally to said animal an effective amount of 2,6-diisopropylphenol.

43. A method as claimed in claim 42 wherein there is administered intravenously between 2.5 and 10 mg. of 2,6-diisopropylphenol per kg. bodyweight of the animal.

44. A composition as claimed in any of claims 1 to 41 as hereinbefore particularly described in any one of Examples 1 to 14 and 21 to 23.

45. A method as claimed in claim 42 or 43 as hereinbefore particularly described in any one of Examples 15 to 20.

46. A sterile pharmaceutical composition which comprises the compound 2,6-diisopropylphenol in association with a sterile liquid diluent or carrier, the composition being suitable for parenteral administration to a warm-blooded animal.

47. A composition as claimed in claim 46 which comprises the compound 2,6-diisopropylphenol in admixture with water and a surfactant, and which may optionally contain one or more additional solvents.

48. A composition as claimed in claim 47 wherein the additional solvent is propylene glycol or ethanol.

49. A composition as claimed in claim 47 or 48 wherein the surfactant is a polyoxyethylated ricinoleic acid derivative or a polyoxyethylene - polyoxypropylene block copolymer.

50. A composition as claimed in any of claims 46 to 49 which is made isotonic with blood by the incorporation of the required amount of sodium chloride.

51. A composition as claimed in any of claims 46, 47 or 49 as hereinbefore particularly described in Example 1.

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