PFIZER CORPORATION

of Calle 15½, Avenida Santa Isabel
Colon, Republic of Panama

hereby apply for the grant of a standard patent
for an invention entitled

"2-SUBSTITUTED 4-AMINO-6,7-DIMETHOXYQUINOLINES"

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION(s)
Number(s) of Basic Application(s) 8221457
Name(s) of Convention Country(ies) in which Basic Application(s) were filed Great Britain

Date(s) of Basic Application(s) 24th July, 1982
(respectively)

Our address for service is: Spruson & Ferguson
PATENT ATTORNEYS
CBA CENTRE, 60 MARGARET ST.
SYDNEY, NEW SOUTH WALES
AUSTRALIA

Dated this FIFTH day of JULY 1983

PFIZER CORPORATION

By: ____________________________ Registered Patent Attorney

To: The Commissioner of Patents
Title of Invention
"2-SUBSTITUTED 4-AMINO-6,7-DIMETHOXYQUINOLINES"

I & We William John Wilson

of Broomhill, Wingham, Nr. Canterbury, Kent, England

do solemnly and sincerely declare as follows:

1. I & We are the applicant(s) for the patent
   (or, in the case of an application by a body corporate)
   the applicant(s) for the patent to make this declaration on
   its/their behalf.

2. The basic application(s) as defined by Section 141 of the
   Act was/were made

   (in Great Britain)
   on 24 July 1982
   by PFIZER LIMITED

3. Simon Fraser Campbell and John David Hardstone
   Grey Friars, Upper Street, Kingsdown, Deal, Kent, England
   and
   The Cabin, Felderland Lane, Worth, Deal, Kent, England
   (respectively)
   are the actual inventor(s) of the invention and the facts upon
   which he/she/they is/are entitled to make the application are
   as follows: PFIZER CORPORATION is the assignee of PFIZER LIMITED
   and PFIZER LIMITED was entitled by Contract of Employment
   between the inventors and employees of PFIZER LIMITED as
   employer, as a person who would be entitled to have the
   patent assigned to it if a patent were granted upon an
   application made by the inventors.

4. The basic application(s) referred to in paragraph 2 of this
   Declaration was/were the first application(s) made in a Convention
   country in respect of the invention(s) the subject of the application.

Declared at
Kent, England
this 3rd day of
June 1983

To: The Commissioner of Patents

Signature of Declarant(s)

Abstract
Claim
1. A compound of the formula:

\[
\begin{array}{c}
\text{CH}_3 \\
\text{CH}_3 \\
\text{NH}_2 \\
\end{array}
\]

of a pharmaceutically acceptable acid addition salt thereof,
wherein R is \(-\text{N}_2\text{C}_1\text{C}_4\text{ alkyl}\)_2, piperidino, 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl or a group of the formula

\[
\begin{array}{c}
\text{N} \\
\text{N-Y where Y is H, } \text{C}_1\text{C}_6 \text{ alkyl, ary1, C}_1\text{C}_4 \text{ alkyl} \\
\end{array}
\]

substituted by ary1, or a nitrogen-containing aromatic heterocyclic group attached to the adjacent nitrogen atom of the
piperazinyl group by a carbon atom, or Y is selected from
(a) -COR\textsuperscript{1} where R\textsuperscript{1} is C\textsubscript{1}-C\textsubscript{6} alkyl, C\textsubscript{1}-C\textsubscript{4} alkyl substituted by
aryl, C\textsubscript{3}-C\textsubscript{6} cycloalkyl, (C\textsubscript{3}-C\textsubscript{6} cycloalkyl)methyl, aryl, styryl or
a heterocyclic group;
(b) -CONHR\textsuperscript{2} where R\textsuperscript{2} is C\textsubscript{1}-C\textsubscript{6} alkyl, aryl, C\textsubscript{1}-C\textsubscript{4} alkyl
substituted by aryl, (C\textsubscript{2}-C\textsubscript{4} alkenyl)methyl, C\textsubscript{3}-C\textsubscript{6} cycloalkyl or
(C\textsubscript{3}-C\textsubscript{6} cycloalkyl)methyl; and
(c) -COOR\textsuperscript{3} where R\textsuperscript{3} is C\textsubscript{1}-C\textsubscript{6} alkyl, C\textsubscript{1}-C\textsubscript{4} alkyl substituted by
aryl, C\textsubscript{2}-C\textsubscript{4} alkyl substituted other than on an \textalpha-carbon atom by
hydroxy, C\textsubscript{3}-C\textsubscript{6} cycloalkyl, (C\textsubscript{3}-C\textsubscript{6} cycloalkyl)methyl, (C\textsubscript{2}-C\textsubscript{4}
alkenyl)methyl, or aryl.

9. A pharmaceutical composition comprising a compound as
claimed in any of claims 1 to 8 and a pharmaceutically acceptable
carrier material.
To: The Commissioner of Patents

Registered Patent Attorney

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

COMPLETE SPECIFICATION
(ORIGINAL)

FOR OFFICE USE:

Application Number:
Lodged: 17222/83

Complete Specification Lodged: 
Accepted: 
Published: 

Priority: 

Related Art: 

Name of Applicant(s): PFIZER CORPORATION

Address of Applicant(s): Calle 15½, Avenida Santa Isabel
Colon, Republic of Panama

Actual Inventor(s): SIMON FRASER CAMPBELL and JOHN DAVID HARDSTONE

Address for Service: Spruson & Ferguson, Patent Attorneys, CBA Centre
60 Margaret Street, Sydney, New South Wales, 2000 Australia

Complete Specification for the invention entitled:
"2-SUBSTITUTED 4-AMINO-6,7-DIMETHOXYQUINOLINES"

The following statement is a full description of this invention, including the best method of performing it known to us:

10/82
Abstract

2-Substituted 4-Amino-6,7-Dimethoxyquinolines

Novel derivatives of 4-amino-6,7-dimethoxyquinoline are disclosed as regulators of the cardiovascular system, in particular as antihypertensive agents, which have the formula:

\[
\begin{align*}
\text{CH}_3 \text{O} & \text{N} \text{R} \\
\text{CH}_3 \text{O} & \text{NH}_2 \\
\end{align*}
\]

where \( R \) is a dialkylamino, piperidino or 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl group, or a piperazino group optionally substituted in the 4-position by an alkyl, aryl, aromatic heterocyclyl, acyl, N-substituted carbamoyl or esterified carboxyl group. Preparation of such compounds by cyclisation of N-1R-substituted-ethylidene)-2-cyano-4,5-dimethoxy-anilines, and by appropriate treatment of the compound in which \( R \) is an unsubstituted piperazino group, is described.
This invention relates to therapeutic agents which are novel derivatives of 4-amino-6,7-dimethoxyquinoline. Such compounds are useful as regulators of the cardiovascular system and, in particular, in the treatment of hypertension.

The novel compounds according to the invention are those having the formula:

![Chemical Structure](image)

and their pharmaceutically acceptable acid addition salts, wherein R is \(-\text{N(C}_1\text{-C}_4\text{ alkyl)}\)_2, piperidino, 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl or a group of the formula \(-\text{N} -\text{Y}\) where Y is H, \(\text{C}_1\text{-C}_6\) alkyl, aryl, \(\text{C}_1\text{-C}_4\) alkyl substituted by aryl, or a nitrogen-containing aromatic heterocyclic group attached to the adjacent nitrogen atom of the piperazinyl group by a carbon atom, or Y is selected from

(a) \(-\text{COR}^1\) where \(\text{R}^1\) is \(\text{C}_1\text{-C}_6\) alkyl, \(\text{C}_1\text{-C}_4\) alkyl substituted by aryl, \(\text{C}_3\text{-C}_6\) cycloalkyl, \((\text{C}_3\text{-C}_6\) cycloalkyl)methyl, aryl, styryl or a heterocyclic group;
- 3 -

(b) \(-\text{CONHR}^2\) where \(R^2\) is \(C_1-C_6\) alkyl, aryl, \(C_1-C_4\) alkyl substituted by aryl, \((C_2-C_4\) alkenyl)methyl, \(C_3-C_6\) cycloalkyl or \((C_3-C_6\) cycloalkyl)methyl; and

(c) \(-\text{COOR}^3\) where \(R^3\) is \(C_1-C_6\) alkyl, \(C_1-C_4\) alkyl substituted by aryl, \(C_2-C_4\) alkyl substituted other than on an \(\alpha\)-carbon atom by hydroxy, \(C_3-C_6\) cycloalkyl, \((C_3-C_6\) cycloalkyl)methyl, \((C_2-C_4\) alkenyl)methyl, or aryl.

The preferred aryl groups are phenyl and naphthyl, and said phenyl group can be substituted by, for example, 1 or 2 substituents each selected from halo, \(\text{CF}_3\), \(C_1-C_4\) alkyl and \(C_1-C_4\) alkoxy, or by a single methylenedioxy group.

"Halo" means F, Cl, Br or I.

Alkyl, alkoxy and alkenyl groups can be straight or, when appropriate, branched chain. Preferred alkyl groups have 1 to 4 carbon atoms.

Pharmaceutically acceptable acid addition salts of the compounds of the invention are those formed from acids which form non-toxic acid addition salts containing pharmaceutically acceptable anions, such as the hydrochloride, hydrobromide, sulphate or bisulphate, phosphate or acid phosphate, acetate, maleate, fumarate, succinate, lactate, tartrate, citrate, gluconate and \(p\)-toluenesulphonate salts.
Examples of $R_1$ include

- phenyl, $p$-fluorophenyl, methyl, cyclopropylmethyl, cyclopentyl, styryl, 2-naphthyl and 2-quinolyl.

Examples of $R_2$ include phenyl, cyclopropylmethyl, benzyl, $n$-propyl and allyl.

Examples of $R_3$ include ethyl, $-\text{CH}_2\text{CH}(_2)_2$, $-\text{CH}_2\text{C}(_2\text{H}_5)_2\text{OH}$, cyclopropylmethyl, $p$-fluorophenyl, benzyl and $-\text{CH}_2\text{C}(_2\text{H}_5)=\text{CH}_2$.

When $Y$ is said nitrogen-containing aromatic heterocyclic group, this includes, for example, the following:

- $\text{N}^{-}\text{CH}_3\text{O}$
- $\text{N}^{-}\text{CH}_2\text{H}_5$
- $\text{N}^{-}\text{NHC}_{6\text{H}}_5$
- $\text{N}^{-}\text{CR}_3$
- $\text{N}^{-}\text{CR}_2$
- $\text{N}^{-}\text{Cl}$
- $\text{N}^{-}\text{O}^\text{-Pr}$
- $\text{N}^{-}\text{CH}_3$
- $\text{N}^{-}\text{NHC}_{6\text{H}}_5$

and

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The compounds of the formula (I), can be prepared as follows:—

(1) An N-(1R-substituted-ethylidene)-2-cyano-4,5-dimethoxy-
aniline (II) may be cyclised to form the correspondingly
substituted 4-amino-6,7-dimethoxyquinoline (II):—

\[
\begin{align*}
\text{CH}_3O & \quad \text{N} \quad \text{R} \\
\text{N} & \quad \text{R} \\
\text{CH}_3O & \quad \text{CN} \\
\text{H}_3O & \quad \text{CH}_3O \\
\text{N} & \quad \text{NH}_2 \\
\text{cyclisation} & \quad \text{II} \\
\end{align*}
\]

The cyclisation can be carried out using a Lewis acid, e.g. zinc chloride, or a base, e.g. lithium diisopropylamide (LDA). Zinc chloride is preferred when \( R \) is said tetrahydroisoquinolyl group or an \( N \)-aralkyl-piperazino group. The reaction with zinc chloride is typically carried out by heating the reactants, preferably at reflux, in a suitable organic solvent, e.g. dimethylacetamide, for up to about 4 hours. The reaction with LDA is typically carried out at low temperature (e.g. \(-70^\circ C\)) in a suitable organic solvent, e.g. tetrahydrofuran, following which the reaction mixture is allowed to warm to room temperature. In some cases using LDA, heating may be necessary to complete the reaction. The product can then be isolated and purified conventionally.
The compounds (II) are obtainable conventionally as is illustrated in the following Preparations. Typical methods are outlined as follows:-

(a) For compounds where R is as defined above except for unsubstituted piperazinyl (Y = H):

(b) For compounds in which R is unsubstituted piperazinyl:
(2) The Compound in which R is -NH can also be prepared by
debenzylation of the corresponding 4-benzylpiperazin-1-yl
compound, itself preparable via route (1) above. This can be
carried out conventionally using, e.g., H₂ over a Pd/C catalyst.

(3) Compounds in which Y is -COR₁ can be prepared as follows:-

Q is a facile leaving group, preferably Cl.

The reaction can be carried out conventionally. When Q is
Cl, the presence of a tertiary amine acid acceptor such as
triethylamine is desirable. Generally, heating is unnecessary.
Typically the reactants are stirred together in a suitable organic
solvent, e.g. chloroform, at 5-10°C for 1-2 hours. The reaction
mixture can then be allowed to attain room temperature and the
product isolated conventionally.

(4) Compounds in which Y is -CONH₂ can be prepared as follows:-
When an isocyanate $\text{R}_2\text{NCO}$ is used, the reaction can again be carried out conventionally, e.g. by stirring the reactants together for a few hours (e.g. 3-6 hours) in a suitable organic solvent, e.g. chloroform. Heating is again generally unnecessary; the product can be isolated routinely.

When a carbamoyl chloride $\text{R}_2\text{NHCOCl}$ is used, this may be generated in situ by the action of phosgene on the amine $\text{R}_2\text{NH}_2$ as its hydrochloride salt in the presence of an acid acceptor such as triethylamine in a dry, cooled organic solvent, such as chloroform at $-40^\circ$. After allowing this to warm to ambient temperature and removing excess phosgene, a solution of the piperazino-quinoline in the same solvent is added slowly with cooling, the mixture stirred until reaction is complete and the product isolated routinely.

(5) Compounds in which $Y$ is $-\text{COOR}^3$ can be prepared as follows:

$$\text{CH}_3\text{O} - \text{N} - \text{N} - \text{NH}_2 $$

where $Q$ is a facile leaving group, preferably CI. Typically the reaction is carried out by stirring the reactants together for a few hours in a suitable organic solvent such as chloroform, preferably, when $Q$ is CI, in the presence of an acid acceptor such as triethylamine. Heating is not generally necessary, and the product can be isolated in a routine manner.

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Compounds in which \( Y \) is said nitrogen-containing aromatic heterocyclic group can be prepared as follows:

\[
\begin{align*}
&\text{CH}_3\text{O} \quad \text{N} \quad \text{NH} \\
&\text{CH}_3\text{O} \quad \text{NH}_2
\end{align*}
\]

\[
\begin{align*}
&\text{CH}_3\text{O} \quad \text{N} \quad \text{NH} \\
&\text{CH}_3\text{O} \quad \text{NH}_2
\end{align*}
\]

where \( Q \) is a facile leaving group, preferably Cl. The reaction is typically carried out by heating the reactants, preferably under reflux, in a suitable organic solvent, e.g., n-butanol, for up to about 24 hours, after which the product can be isolated conventionally.

Certain compounds of the invention can be converted to other compounds of the invention by conventional means, e.g., a chlorine substituent on an aromatic heterocyclic group \( Y \) can be replaced by a phenoxyl group or an amino group by reaction with phenol or an amine, respectively, under conditions well known in the art, and an alkenyl-methyl group \( R^3 \) can be converted to a hydroxyalkyl-methyl group by treatment with concentrated sulphuric acid, as is also well known in the art.

The pharmaceutically acceptable acid addition salts of the compounds of the formula (I) can be prepared by conventional procedures, e.g., by reacting the free base with the appropriate acid in an inert organic solvent, and collecting the resulting precipitate of the salt by filtration or by evaporation of the reaction mixture. If necessary, the product may then be recrystallised to purify it.
When the compounds of the invention contain an asymmetric centre, the invention includes both the resolved and unresolved forms. Resolution of optically active isomers can be carried out according to conventional prior art methods.

The antihypertensive activity of the compounds of the formula (I) is shown by their ability to lower the blood pressure of conscious spontaneously hypertensive rats and conscious renally hypertensive dogs, when administered orally at doses of up to 5 mg/kg.

The compounds of the formula (I) and their salts can be administered alone, but will generally be administered in admixture with a pharmaceutical carrier selected with regard to the intended route of administration and standard pharmaceutical practice. For example, they can be administered orally in the form of tablets containing such excipients as starch or lactose, or in capsules either alone or in admixture with excipients, or in the form of elixirs or suspensions containing flavouring or colouring agents. They can be injected parenterally, for example, intramuscularly, intravenously or subcutaneously. For parenteral administration, they are best used in the form of a sterile aqueous solution which may contain other solutes, for example, enough salt or glucose to make the solution isotonic.

Thus the invention also provides a pharmaceutical composition comprising a compound of the formula (I) or pharmaceutically acceptable acid addition salt thereof together with a pharmaceutically acceptable diluent or carrier.
It also provides a compound of the formula (I), or a pharmaceutically acceptable acid addition salt thereof, for use in treating hypertension in a human being.

The compounds of the formula (I) and their salts can be administered to humans for the treatment of hypertension by either the oral or parenteral routes, and will be administered orally at dosage levels within the range 1 to 50 mg/day for an average adult patient (70 kg), given in a single dose or up to 3 divided doses. Intravenous dosage levels will be 1/5th to 1/10th of the daily oral dose. Thus for an average adult patient, individual oral doses in tablet or capsule form will be approximately in the range from 1 to 25 mg of the active compound. It should however be stated that variations will necessarily occur depending on the weight and condition of the subject being treated and the particular route of administration chosen as will be known to those skilled in the art.

The invention yet further provides a method of treating a human being having hypertension, which comprises administering to the human an antihypertensive amount of a compound of the formula (I) or pharmaceutically acceptable acid addition salt thereof or pharmaceutical composition as defined above.

The following Examples illustrate the invention. All temperatures are in °C:
EXAMPLE 1

A solution of 1,4-benzodioxan-2-carbonyl chloride (0.75 g) in chloroform (10 ml) was added dropwise to a stirred solution of 4-amino-6,7-dimethoxy-2-(piperazin-1-yl)quinoline (1.0 g) in chloroform (50 ml) with triethylamine (1.06 g) at 5-10°. The reaction was stirred at 5-10° for one hour, then allowed to attain room temperature and stirred overnight. The mixture was then evaporated in vacuo and the residue partitioned between chloroform (50 ml) and sodium carbonate solution (10%, 50 ml). The chloroform layer was separated, the aqueous phase extracted with chloroform (2 x 50 ml), the extracts combined, washed with brine, dried (Na₂SO₄) and evaporated in vacuo. The residue was then purified by chromatography on silica (Merck 9385, 60) eluting with chloroform/methanol (100:0 → 97:3). A solution of the purified product in chloroform was treated with ethereal hydrogen chloride, evaporated in vacuo and the residue recrystallised from isopropanol to give 4-amino-2-[4-(1,4-benzodioxan-2-carbonyl)piperazin-1-yl]-6,7-dimethoxyquinoline hydrochloride hydrate (0.28 g), m.p. 201°.
Analysis %:-

Found:  
C, 56.7; H, 5.4; N, 11.0.

Calculated for C$_{24}$H$_{26}$N$_4$O$_5$·HCl·H$_2$O: C, 57.1; H, 5.8; N, 11.1

EXAMPLES 2 TO 11

The following compounds were prepared similarly to Example 1, starting from the same quinoline and the appropriate acid chloride as indicated. After chromatography, the product was crystallised from the solvent shown in each case.

\[
\begin{align*}
\text{CH}_3O \quad \text{N} \quad \text{Y} \\
\text{CH}_3O \quad \text{NH}_2
\end{align*}
\]
<table>
<thead>
<tr>
<th>Example No.</th>
<th>Y</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared from, and recrystallised from</th>
<th>Analysis % (Theoretical in brackets)</th>
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<tr>
<td>2</td>
<td><img src="image" alt="Furan" /></td>
<td>Hydrochloride 1/4 hydrate, 270°</td>
<td>2-furoyl chloride, MeOH/Et2O</td>
<td>C 56.7  H 5.5  N 13.5</td>
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<td></td>
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<td>(56.7  5.6  13.2)</td>
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<td>benzoyl chloride, MeOH</td>
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<td></td>
<td></td>
<td>(60.3  6.0  12.8)</td>
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<td><img src="image" alt="Formyl" /></td>
<td>HCl, 1.5 H2O, 215-220°C</td>
<td>Acetyl chloride, (i) EtOH, (ii) MeOH/EtOH</td>
<td>C 52.1  H 6.5  N 14.1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(51.8  6.7  14.2)</td>
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<td><img src="image" alt="Cyclopentane" /></td>
<td>HCl, 292°C</td>
<td>Cyclopentane carbonylchloride, IPA/MeOH 4:1</td>
<td>C 59.4  H 7.0  N 13.5</td>
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<td>(59.9  6.9  13.3)</td>
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<td>6</td>
<td><img src="image" alt="Cinnamoyl" /></td>
<td>HCl, 0.5 H2O, 240-241°C</td>
<td>cinnamoyl chloride, EtOH</td>
<td>C 61.8  H 6.0  N 12.0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(62.1  6.1  12.1)</td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and m.p. (°C)</td>
<td>Prepared from and recrystallised from</td>
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</tr>
<tr>
<td>-------------</td>
<td>-----------------------</td>
<td>-------------------------------------------------</td>
<td>---------------------------------------</td>
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<tr>
<td>2</td>
<td><img src="image" alt="Furanyl" /></td>
<td>Hydrochloride 1/4 hydrate, 270°</td>
<td>2-furoyl chloride, MeOH/Et₂O</td>
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<tr>
<td>3</td>
<td><img src="image" alt="Benzyl" /></td>
<td>Hydrochloride 1/2 hydrate 301°</td>
<td>benzoyl chloride, MeOH</td>
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<td>Acetyl chloride, (i) EtOH (ii) MeOH/EtOH</td>
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<td>5</td>
<td><img src="image" alt="Cyclopentane" /></td>
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<td>HCl, 0.5 H₂O, 240-241°C</td>
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a heterocyclic group;

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<th>(Theoretical in brackets)</th>
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<td>C</td>
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</tr>
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<td>5.5</td>
</tr>
<tr>
<td>(56.7</td>
<td>5.6</td>
</tr>
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<td>5.7</td>
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<td>(62.1</td>
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<td>Example No.</td>
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<tr>
<td>7</td>
<td><img src="image" alt="Chemical Structure" /></td>
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<td>9</td>
<td><img src="image" alt="Chemical Structure" /></td>
</tr>
<tr>
<td>10</td>
<td><img src="image" alt="Chemical Structure" /></td>
</tr>
<tr>
<td>Example No.</td>
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<tr>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>7</td>
<td><img src="example1.png" alt="Image" /></td>
</tr>
<tr>
<td>8</td>
<td><img src="example2.png" alt="Image" /></td>
</tr>
<tr>
<td>9</td>
<td><img src="example3.png" alt="Image" /></td>
</tr>
<tr>
<td>10</td>
<td><img src="example4.png" alt="Image" /></td>
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<td>Analysis % (Theoretical in brackets)</td>
<td>C</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----</td>
</tr>
<tr>
<td>64.3 5.8 11.6</td>
<td>64.0 5.8 11.5</td>
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<tr>
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</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
</tr>
<tr>
<td>------------</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>![Chemical Structure]</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
</tr>
<tr>
<td>------------</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td><img src="image" alt="Chemical Structure" /></td>
</tr>
</tbody>
</table>
reaction is carried out by stirring the reactants together for a few hours in a suitable organic solvent such as chloroform, preferably, when Q is Cl, in the presence of an acid acceptor such as triethylamine. Heating is not generally necessary, and the product can be isolated in a routine manner.

PLC 351C

<table>
<thead>
<tr>
<th></th>
<th>Analysis 1 (Theoretical in brackets)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>H</td>
</tr>
<tr>
<td>ide,</td>
<td>59.6</td>
<td>5.9</td>
</tr>
<tr>
<td>(59.7</td>
<td>6.2</td>
<td>11.1)</td>
</tr>
</tbody>
</table>
Phenylisocyanate (1.1 g) was added to a stirred suspension of 4-amino-6,7-dimethoxy-2-(piperazin-1-yl)quinoline (0.72 g) in chloroform (25 ml) at room temperature and the reaction mixture was stirred for 4 hours. The mixture was evaporated in vacuo, the residue taken up in methanol-chloroform and treated with ethereal hydrogen chloride. The crude product was purified by chromatography on silica gel eluting with methylene chloride followed by chloroform/methanol and then recrystallised from methanol/ether to give 4-amino-6,7-dimethoxy-2-[4-(N-phenylcarbamoyl)piperazin-1-yl]quinoline dihydrochloride (0.18 g), m.p. 235°.

Analysis %:-

Found: C,55.1; H,5.7; N,14.7

Calculated for C_{22}H_{25}N_5O_3.2HCl: C,55.0; H,5.7; N,14.6.
composition comprising a compound of the formula (I) or pharmaceutically acceptable acid addition salt thereof together with a pharmaceutically acceptable diluent or carrier.

EXERCISES 13 TO 15

The following compounds were prepared similarly to Example 12, using the appropriate isocyanate R₂NCO as indicated, and the product crystallised from the solvent shown in each case.

![Chemical Structure Image]

In Example 13 chromatography was not necessary, while in Examples 14 and 15 the reaction mixtures were purified as in Example 16, i.e. chromatographed as the free base and (in the case of Example 14) then converted to the hydrochloride.
<table>
<thead>
<tr>
<th>Example No.</th>
<th>$R^2$</th>
<th>Form Isolated and m.p. ($^\circ$C)</th>
<th>Prepared from, and recrystallised from</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>$-\text{CH}_2\text{CH}_2\text{CH}_3$</td>
<td>$\text{HCl.1.5H}_2\text{O}$ 200$^\circ$ (d)$^c$</td>
<td>n-propyl isocyanate, MeOH/F$_2$O</td>
<td>54.0 6.8 16.7 (54.5 7.0 16.7)</td>
</tr>
<tr>
<td>14</td>
<td>$-\text{CH}_2\text{C}_6\text{H}_5$</td>
<td>$\text{HCl}$, 269-270$^\circ$C</td>
<td>Benzyl isocyanate, IPA</td>
<td>59.8 6.1 14.9 (60.3 6.2 15.3)</td>
</tr>
<tr>
<td>15</td>
<td>$-\text{CH}_2\text{CH}=$CH$_2$</td>
<td>$\text{H}_2\text{O}$, 178-181$^\circ$C (d)</td>
<td>Allyl isocyanate, EtOAc/CH$_2$Cl$_2$/hexane</td>
<td>58.3 6.7 17.8 (58.6 7.0 18.0)</td>
</tr>
</tbody>
</table>
benzodioxan-2-carbonyl)piperazin-1-yl]-6,7-dimethoxyquinoline hydrochloride hydrate (0.28 g), m.p. 201°.

**Example R2 Form Isolated Prepared from, and Analysis**

<table>
<thead>
<tr>
<th>Example No.</th>
<th>$R^2$</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared from, and recrystallised from (Theoretical in brackets)</th>
<th>Analysis % (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>-CH$_2$CH$_2$-CH$_3$</td>
<td>HCl.1.5H$_2$O 200° (d)$^2$</td>
<td>n-propyl isocyanate, MeOH/Et$_2$O</td>
<td>54.0 6.8 16.7 (54.5 7.0 16.7)</td>
</tr>
<tr>
<td>14</td>
<td>-CH$_2$C$_6$H$_5$</td>
<td>HCl, 269-270°C</td>
<td>Benzyl isocyanate, IPA</td>
<td>59.8 6.1 14.9 (60.3 6.2 15.3)</td>
</tr>
<tr>
<td>15</td>
<td>-CH$_2$CH=CH$_2$</td>
<td>H$_2$O, 178-181°C (d)</td>
<td>Allyl isocyanate, EtOAc/CH$_2$Cl$_2$/hexane</td>
<td>58.3 6.7 17.8 (58.6 7.0 18.0)</td>
</tr>
<tr>
<td>Sample</td>
<td>Analysis % (Theoretical in brackets)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>C</strong></td>
<td><strong>H</strong></td>
<td><strong>N</strong></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>54.0</td>
<td>6.8</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(54.5</td>
<td>7.0</td>
<td>16.7)</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>59.8</td>
<td>6.1</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(60.3</td>
<td>6.2</td>
<td>15.3)</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>58.3</td>
<td>6.7</td>
<td>17.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(58.6</td>
<td>7.0</td>
<td>18.0)</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE 16

(Aminomethyl)cyclopropane hydrochloride (0.25 g) and triethylamine (0.61 g) in P$_2$O$_5$-dried chloroform (15 ml) was added dropwise to a stirred solution of phosgene in toluene (12.5%, 2.6 ml) at -40°. The reaction mixture was allowed to warm to room temperature and stirred for 0.5 hours. Excess phosgene was removed in a steam of nitrogen then a solution of 4-amino-6,7-dimethoxy-2-(piperazin-1-yl)quinoline (0.3 g) in P$_2$O$_5$-dried chloroform (30 ml) was added dropwise at 10° and the reaction mixture stirred at room temperature for 1.5 hours. Sodium carbonate solution (10%, 10 ml) was then added and the chloroform layer separated. The aqueous phase was extracted with chloroform, the organic phases combined, washed with water, dried (MgSO$_4$) and
evaporated \textit{in vacuo}. The residue was then taken up in methylene chloride and chromatographed on silica (Merck 9385, 85 g) eluting with methylene chloride/methanol (100:0 \rightarrow 85:15). A solution of the purified product in methylene chloride was treated with ethereal hydrogen chloride, evaporated \textit{in vacuo} and the residue recrystallised from isopropanol to give 4-amino-2-[4-\((N\text{-cyclopropylmethylcarbamoyl)}\text{piperazin-1-yl)}\]6,7-dimethoxyquinoline hydrochloride hemihydrate (165 mg), m.p. 220-223\degree (d).

Analysis %:

\begin{align*}
\text{Found: } & \quad C, 55.6; \quad H, 6.5; \quad N, 16.4 \\
\text{Calculated for } & \quad C_{20}H_{27}N_{5}O_{3} \cdot HCl, 0.5 H_{2}O: \quad C, 55.7; \quad H, 6.8; \quad N, 16.3.
\end{align*}

\section*{EXAMPLE 17}

\begin{align*}
\text{4-Amino-6,7-dimethoxy-2-(piperazin-1-yl)quinoline (1.26 g) and 2-chloro-4-dimethylaminopyrimidine (0.76 g in n-butanol (60 ml) were heated under reflux for 16 hours. The mixture was then evaporated \textit{in vacuo}, the residue partitioned between chloroform and sodium carbonate solution (10\%) and the aqueous phase.}
\end{align*}

PLC 351c
extracted with chloroform. The combined extracts were washed with water, dried (Na$_2$SO$_4$), evaporated in vacuo and the residue chromatographed on silica gel (Merck 9385). Elution with chloroform-methanol (100:0 → 95.5) followed by treatment of the product with ethereal hydrogen chloride and recrystallisation from methanol gave 4-amino-6,7-dimethoxy-2-[4-(4-dimethylamino-pyrimidin-2-yl)piperazin-1-yl]quinoline dihydrochloride dihydrate (0.19 g), m.p. 260-263°.

**Analysis**

*Found:* C, 48.4; H, 5.8; N, 18.9.

*Calculated for C$_{21}$H$_{27}$N$_7$·2HCl·2H$_2$O:* C, 48.7; H, 6.4; N, 18.9.

**EXAMPLES 18 TO 26**

The following compounds were prepared similarly to Example 18, using the appropriate halogenated heterocyclic compound YQ as indicated, and the product crystallised from the solvent shown in each case. In Example 20 chromatography was not necessary.
<table>
<thead>
<tr>
<th>Example No.</th>
<th>Y</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared from, and recrystallised from</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td><img src="image" alt="Molecule" /></td>
<td>HCl.2 H₂O 271°</td>
<td>2-chlorobenzo-oxazole, MeOH</td>
<td>C: 55.6 H: 5.5 N: 14.2 (55.3 5.9 14.7)</td>
</tr>
<tr>
<td>19</td>
<td><img src="image" alt="Molecule" /></td>
<td>2HCl.CH₃OH, 282-283°</td>
<td>2-chloro-4-methylpyrimidine, MeOH</td>
<td>C: 51.7 H: 6.1 N: 17.8 (52.0 6.2 17.3)</td>
</tr>
<tr>
<td>20</td>
<td><img src="image" alt="Molecule" /></td>
<td>HCl.2H₂O 267-265°</td>
<td>2-chloro-4-ethoxy pyrimidine, EtOH</td>
<td>C: 51.7 H: 5.8 N: 17.2 (52.2 6.5 17.4)</td>
</tr>
<tr>
<td>21</td>
<td><img src="image" alt="Molecule" /></td>
<td>2HCl.1.5 H₂O 266-268° dec.</td>
<td>6-chloro-2,4-dimethoxytriazine, MeOH</td>
<td>C: 45.2 H: 5.1 N: 18.5 (45.5 5.7 18.6)</td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and m.p. (°C)</td>
<td>Prepared from, and recrystallised from</td>
<td>Analysis % (Theoretical in brackets) C</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------</td>
<td>-----------------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>18</td>
<td><img src="123" alt="Image" /></td>
<td>HCl.2 H₂O, 271°</td>
<td>2-chlorobenzoxazole, MeOH</td>
<td>53.6 5.5 14.2</td>
</tr>
<tr>
<td>19</td>
<td><img src="456" alt="Image" /></td>
<td>2HCl.CH₃OH, 282-283°</td>
<td>2-chloro-4-methylpyrimidine, MeOH</td>
<td>51.7 6.1 17.8</td>
</tr>
<tr>
<td>20</td>
<td><img src="789" alt="Image" /></td>
<td>HCl.2H₂O, 267-269°</td>
<td>2-chloro-4-ethoxypyrimidine, EtOH</td>
<td>51.7 5.8 17.2</td>
</tr>
<tr>
<td>21</td>
<td><img src="1011" alt="Image" /></td>
<td>2HCl.1.5 H₂O, 266-268° dec.</td>
<td>6-chloro-2,4-dimethoxytriazine, MeOH</td>
<td>45.2 5.1 18.5</td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and m.p. (°C)</td>
<td>Prepared from and recrystallised from</td>
<td>Analysis Z (Theoretical in brackets)</td>
</tr>
<tr>
<td>-------------</td>
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<td>-----------------------------</td>
<td>--------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C H N</td>
</tr>
</tbody>
</table>

<p>| Prepared from, recrystallised from (Theoretical in brackets) |
|-------------------------------------------------------------|---------------------------------------------------------------|
| 6-chloro-2,4-dimethoxy-1,3-oxazine, MeOH                  |
| 2-chloro-1,3-ethoxypyrimidine, MeOH (55.3 5.9 14.7)         |
| 2-chloro-4-methylpyrimidine, MeOH (52.0 6.2 17.3)           |
| 2-chloro-4-ethoxypyrimidine, EtOH (52.2 6.5 17.4)           |
| 6-chloro-2,4-dimethoxy-1,3-dimethyltriazine, MeOH (45.5 5.7 18.5) |
| 2-chloro-4-ethyl-1,3-dimethyltriazine, MeOH (45.2 5.1 18.5) |
| 2-chloro-4-ethyl-1,3-dimethyltriazine, MeOH (51.7 5.8 17.2) |
| 2-chloro-4-ethyl-1,3-dimethyltriazine, MeOH (51.7 6.1 17.8) |
| 2-chloro-4-ethyl-1,3-dimethyltriazine, MeOH (55.6 5.5 16.2) |
| 2-chloro-4-ethyl-1,3-dimethyltriazine, MeOH (55.3 5.9 16.7) |</p>
<table>
<thead>
<tr>
<th>Example No.</th>
<th>Y</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared from and recrystallised from</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td><img src="image1" alt="" /></td>
<td>2HCl 1.5 H₂O, 247-248°C</td>
<td>6-chloro-2,4-bis (ethylamino) triazine, MeOH</td>
<td>C: 47.8 H: 6.2 N: 22.5 (C: 47.7 H: 6.6 N: 22.8)</td>
</tr>
<tr>
<td>23</td>
<td><img src="image2" alt="" /></td>
<td>H₂O 262-266°C dec.</td>
<td>3,6-dichloropyridazine, not recryst.</td>
<td>C: 54.3 H: 5.2 N: 19.9 (C: 54.5 H: 5.5 N: 20.1)</td>
</tr>
<tr>
<td>24</td>
<td><img src="image3" alt="" /></td>
<td>2HCl, 244-247°C dec.</td>
<td>2-Bromothiazole, MeOH</td>
<td>C: 49.2 H: 5.2 N: 15.8 (C: 48.7 H: 5.2 N: 15.8)</td>
</tr>
<tr>
<td>25</td>
<td><img src="image4" alt="" /></td>
<td>2HCl 3H₂O, 245-252°C dec.</td>
<td>2-chloro-1-methylbenzimidazole, MeOH</td>
<td>C: 50.3 H: 5.5 N: 14.8 (C: 50.6 H: 6.3 N: 15.4)</td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and m.p. (°C)</td>
<td>Prepared from recrystallization</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---</td>
<td>----------------------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td><img src="image1" alt="Structure1" /></td>
<td>2HCl 1.5 H₂O, 247-248°C</td>
<td>6-chloro-2, (ethylamino) triazine, MeOH</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td><img src="image2" alt="Structure2" /></td>
<td>H₂O 262-266°C dec.</td>
<td>3,6-dichloropyridazine, not recrystallized</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td><img src="image3" alt="Structure3" /></td>
<td>2HCl, 244-247°C dec.</td>
<td>2-Bromothiazole, MeOH</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td><img src="image4" alt="Structure4" /></td>
<td>2HCl 3H₂O, 245-252°C dec.</td>
<td>2-chloro-1-methylbenzimidazole,</td>
<td></td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and Mp. (°C)</td>
<td>Prepared from and Recrystallized from</td>
<td>Analysis % (Theoretical in brackets)</td>
</tr>
<tr>
<td>------------</td>
<td>---</td>
<td>---------------------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example No.</td>
<td>Y</td>
<td>Form Isolated and m.p. (°C)</td>
<td>Prepared from and recrystallised from</td>
<td>Analysis % (Theoretical in brackets)</td>
</tr>
<tr>
<td>------------</td>
<td>---</td>
<td>-----------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>26</td>
<td>![Cl]</td>
<td>0.5 H₂O, 245-247°C</td>
<td>2,4-dichloropyrimidine, (1) not recrys</td>
<td>C 55.2  H 5.5  N 20.2</td>
</tr>
<tr>
<td></td>
<td>![Cl]</td>
<td></td>
<td>(55.7  5.4  20.5)</td>
<td></td>
</tr>
</tbody>
</table>

(1) carried out in ethanol at room temperature in the presence of triethylamine.
<table>
<thead>
<tr>
<th>Example No.</th>
<th>Y</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared from recrystallised</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td><img src="attachment" alt="Chemical Structure" /></td>
<td>0.5 H₂O, 245-247°C</td>
<td>2,4-dichloropyrimidine, (1) not recryst.</td>
</tr>
</tbody>
</table>

(1) carried out in ethanol at room temperature in the presence of triethylamine.
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Analysis %</th>
<th>( C )</th>
<th>( H )</th>
<th>( N )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( (55.2)</td>
<td>5.5</td>
<td>20.2</td>
<td></td>
</tr>
<tr>
<td>( (55.7)</td>
<td>5.4</td>
<td>20.5</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE 27

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{N} \\
\text{CH}_3\text{O} & \quad \text{N} \\
\text{NH}_2 & \\
\end{align*}
\]

\[
\begin{align*}
\text{Cl} & \\
\text{OH} & \\
\text{HO} & \\
\end{align*}
\]

an\(\text{h. } \text{K}_2\text{CO}_3 \rightarrow
\)

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{N} \\
\text{NH}_2 & \\
\end{align*}
\]

4-Amino-2-[4-(2-chloropyrimidin-4-yl)piperazin-1-yl]-6,7-
dimethoxyquinoline hemihydrate (0.32 g), phenol (0.15 g),
anhydrous potassium carbonate (0.22 g) and potassium iodide
(catalytic trace) in 4-methyl-2-pentanone (125 ml) were stirred
under reflux for 18 hours. Further portions of phenol, anhydrous
potassium carbonate and potassium iodide were then added thrice at
8 hour intervals, followed by a final 18 hours refluxing. After
cooling, methylene chloride (50 ml) and methanol (20 ml) were
added and the reaction mixture filtered. The filtrate was
\text{evaporated in vacuo} and the residue dissolved in methylene
chloride, washed with water, dried (\text{MgSO}_4) and evaporated \text{in}
\text{vacuo}. Chromatography on silica (Merck 9385, 40 g) eluting with

\text{PLC 35E}.
methylene chloride/methanol (100:0 → 88:12) followed by treatment of the product with ethereal hydrogen chloride and recrystallisation from isopropanol gave 4-amino-6,7-dimethoxy-2-[4-(2-phenoxypyrimidin-4-yl)piperazin-1-yl]quinoline dihydrochloride (0.26 g), m.p. 199-201° (d).

Analysis %:-

Found: C, 56.1; H, 5.2; N, 15.7
Calculated for C_{20}H_{25}N_{6}O_{2}·2HCl: C, 56.5; H, 5.3; N, 15.8.

EXAMPLE 28

\[
\begin{align*}
\text{CH}_3 & \quad \text{N} \\
\text{CH}_3 & \quad \text{O} \\
\text{NH}_2 &
\end{align*}
\quad \text{N} \\
\text{CH}_3 & \quad \text{N} \\
\text{O} & \quad \text{CL} \\
\text{CH}_3 & \quad \text{N} \\
\text{NH}_2 &
\]

\[+ \quad \text{HN} \quad \text{CH}_3
\]

\[\rightarrow \quad \text{CH}_3 \quad \text{O} \\
\text{CH}_3 & \quad \text{O} \\
\text{NH}_2 &
\]

nBuOH

PLC 351C
the organic phases combined, washed with water, dried ($\text{MgSO}_4$) and

5. The mixture was then evaporated \textit{in vacuo}, the residue partitioned between chloroform and sodium carbonate solution (10%) and the aqueous phase extracted with chloroform. The combined extracts were washed with water, dried ($\text{MgSO}_4$), evaporated \textit{in vacuo} and the residue chromatographed on silica gel (Merck 9385, 50 g). Elution with methylene chloride/methanol (100.0 : 85:15) followed by treatment of the product with ethereal hydrogen chloride and recrystallisation from isopropanol/ether gave

4-amino-6,7-dimethoxy-2-[(4-(2-N-methylcyclopentylaminopyrimidin-4-yl)piperazin-1-yl]-quinoline dihydrochloride sesquihydrate (0.06 g), m.p. 248-250°.

15. \textit{Analysis}:-

\textit{Found:} C, 53.6; H, 6.5; N, 17.2

Calculated for $C_{25}H_{33}N_7O_2 \cdot 2\text{HCl} \cdot 1.5\text{H}_2\text{O}:$ C, 53.3; H, 6.8; N, 17.4.

\textbf{EXAMPLE 29}

\begin{center}
\includegraphics{example29.png}
\end{center}

\begin{center}
\includegraphics{example29.png}
\end{center}
N-[1-(4-Phenylpiperazin-1-yl)ethylidene]-2-cyano-4,5-dimethoxyaniline (2.5 g) in tetrahydrofuran (35 ml) was added to a stirred solution of lithium diisopropylamide [from n-butyl lithium 1.3M in hexane (6.44 ml) and diisopropylamine (1.44 ml)] in tetrahydrofuran (5 ml) at -70°. The resulting solution was stirred at -70° for 4 hours then allowed to attain room temperature overnight. The mixture was poured into ice-water (100 ml), extracted with chloform (3 x 200 ml), the combined extracts washed with water, dried (Na₂SO₄) and evaporated in vacuo. The residue was taken up in chloroform/methanol, treated with ethereal hydrogen chloride and recrystallised from methanol to give 4-amino-6,7-dimethoxy-2-[4-phenylpiperazin-1-yl]quinoline dihydrochloride hemihydrate (0.82 g) m.p. 288-290°.

Analysis 2:-

<table>
<thead>
<tr>
<th>Found:</th>
<th>Calculated for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>C,56.9; H,6.0; N,12.7</td>
<td>C₂₁H₂₄N₄O₂HCl.½H₂O: C,56.5; H,6.1; N,12.6.</td>
</tr>
</tbody>
</table>
The following compounds were prepared by the same general route as in Example 29, using the appropriate substituted ethyldene compound of formula (II), except that in Example 31 the reaction was completed by heating on a steam bath. In Examples 30 and 32, the crude product was purified by column chromatography.

\[
\begin{aligned}
&\text{CH}_3O \quad \text{N} \quad \text{R} \\
&\text{CH}_3O \quad \text{NH}_2
\end{aligned}
\]

<table>
<thead>
<tr>
<th>Example No.</th>
<th>R</th>
<th>Form isolated m.p.</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>-N</td>
<td>HCl, 272-275°</td>
<td>C 58.9   H 6.9   N 13.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(59.3   6.9   13.0)</td>
</tr>
<tr>
<td>31</td>
<td>CH₃</td>
<td>HCl·H₂O, 285-288°</td>
<td>C 53.8   H 6.3   N 14.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(53.3   6.5   14.4)</td>
</tr>
<tr>
<td>32</td>
<td>-NH</td>
<td>ZHCl·H₂O, 260°</td>
<td>C 47.8   H 6.0   N 15.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(47.5   6.4   14.8)</td>
</tr>
</tbody>
</table>
EXAMPLE 33

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{N} \quad \text{N} \quad \text{NCH}_2\text{C}_6\text{H}_5 \\
\text{CH}_3\text{O} & \quad \text{N} \quad \text{N} \quad \text{NCH}_2\text{C}_6\text{H}_5 \\
\text{CH}_3\text{O} & \quad \text{N} \quad \text{N} \quad \text{NCH}_2\text{C}_6\text{H}_5
\end{align*}
\]

\[
\text{ZnCl}_2 \quad \text{DMA}
\]

N-{l-(4-Benzylpiperazin-l-yl)ethyldene}-2-cyano-4,5-dimethoxyaniline (13.5 g) and zinc chloride (4.86 g) in dimethylacetamide (90 ml) were stirred under reflux for 2½ hours; further zinc chloride (0.5, 0.2 g) was added after ½ and 1½ hours respectively. The mixture was cooled, treated with ether (700 ml, 2 x 100 ml) and the supernatant discarded each time. The residual tar was then treated with sodium hydroxide solution (2N, 100 ml) and methylene chloride (100 ml) and the mixture was stirred at room temperature for 5 minutes. The organic layer was separated, the aqueous phase extracted with methylene chloride and the total organic extracts washed with water. The dried (Na\(_2\)SO\(_4\)) extracts were evaporated in vacuo and the brown residue (~13 g) purified by chromatography on silica gel (Merck 9385, 250 g) eluting with chloroform-methanol (100:0 → 88:12). A sample of the pure product (6.95 g) was taken up in ethanol, treated with ethereal hydrogen chloride and evaporated in vacuo. The residue was recrystallised from methanol to give 4-amino-6,7-dimethoxy-2(4-benzylpiperazin-1-yl)quinoline dihydrochloride sesquihydrate, m.p. 260°-263°.

PLC 351C
Analysis Z:

Found: C, 54.9; H, 5.9; N, 11.5.

Calculated for C₂₂H₂₆N₄O₂.H₂O: C, 55.2; H, 6.5; N, 11.7.

EXAMPLE 3r.

4-Amino-6,7-dimethoxy-2-(6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl)quinoline, m.p. 226-227° was prepared in the same general manner as the previous Example using the corresponding 1-(6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl)ethylidene compound except that the crude reaction residue was recrystallised from isopropanol.

Analysis Z:

Found: C, 66.0; H, 6.3; N, 10.9

Calculated for C₂₂H₂₅N₄O₆: C, 66.8; H, 6.4; N, 10.6.

EXAMPLE 35

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{N} \quad \text{NH} \\
\text{CH}_3\text{O} & \quad \text{NH}_2
\end{align*}
\]

+ 

\[
\begin{align*}
\text{Cl-C.OCH}_2\text{CH(CH}_3)_2
\end{align*}
\]

\[
\begin{align*}
\text{Et}_3\text{N} \quad \text{CH}_3\text{O} & \quad \text{N} \quad \text{NH}_2 \\
\text{CH}_3\text{O} & \quad \text{NH}_2
\end{align*}
\]

PLC 35E
A solution of isobutylchloroformate (0.11 g) in chloroform (3 ml) was added dropwise to a stirred solution of 4-amino-6,7-dimethoxy-2-[piperazin-1-yl]quinoline (0.21 g) in chloroform (15 ml) with triethylamine (0.22 g) at 10°C. The solution was then stirred at room temperature for 1 hour and sodium carbonate solution (10%, 10 ml) added. The organic phase was separated, the aqueous solution extracted with chloroform (2 x 15 ml) and the total combined extracts dried (Na₂SO₄) and evaporated in vacuo.

The residue was purified by chromatography on silica gel (Merck 9385, 25 g) eluting with methylene chloride-methanol (100:0->93:7), followed by treatment of the product with ethereal hydrogenchloride and recrystallisation from isopropanol to give 4-amino-6,7-dimethoxy-2-[4-(isobutoxycarbonyl)-piperazin-1-yl] quinoline hydrochloride sesquihydrate, m.p. 254-256°C (0.065 g).

Analysis:

Found: C, 52.8; H, 6.9; N, 12.2
Calculated for C₂₀H₂₈N₄O₄·HCl·1.5H₂O: C, 53.2; H, 7.1; N, 12.4
The following compounds were prepared similarly to Example 35, using the appropriate chloroformate ClCOOR₃ as indicated, the product being crystallised from the solvent shown in each case. The compound of Example 38 was obtained as a bi-product from Example 37, ethyl chloroformate having been formed *in situ* due to traces of ethanol in the chloroform reaction solvent.

<table>
<thead>
<tr>
<th>Example No.</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Chemical Structure]
<table>
<thead>
<tr>
<th>Example No.</th>
<th>$R^3$</th>
<th>Form Isolated and m.p. ($^\circ$C)</th>
<th>Prepared from and recrystallised from</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td><img src="image" alt="Structure" /></td>
<td>HCl H$_2$O, 244-245$^\circ$C dec.</td>
<td>2-methylallyl chloroformate (1), IPA</td>
<td>C 54.8 6.2 12.7 (54.5 6.6 12.7)</td>
</tr>
<tr>
<td>37</td>
<td>-CH$_2$CH$_3$</td>
<td>HCl 0.5 H$_2$O, 278-279$^\circ$C</td>
<td>Ethyl chloroformate (2), IPA</td>
<td>C 53.5 6.3 13.8 (53.3 6.5 13.8)</td>
</tr>
<tr>
<td>38</td>
<td><img src="image" alt="Structure" /></td>
<td>HCl, 285$^\circ$C</td>
<td>p-Fluorophenyl chloroformate, MeOH</td>
<td>C 56.9 , 5.2 12.1 (57.1 5.2 12.1)</td>
</tr>
<tr>
<td>39</td>
<td>-CH$_2$C$_6$H$_5$</td>
<td>HCl 1.5 H$_2$O, 204-206$^\circ$C dec.</td>
<td>Benzyl chloroformate, MeOH</td>
<td>C 57.2 5.8 12.0 (56.8 6.2 11.5)</td>
</tr>
</tbody>
</table>

(1) Prepared in situ. (2) Formed in situ.
<table>
<thead>
<tr>
<th>Example No.</th>
<th>R&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Form Isolated and m.p. (°C)</th>
<th>Prepared for recrystallisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>CH&lt;sub&gt;3&lt;/sub&gt;</td>
<td>HCl H&lt;sub&gt;2&lt;/sub&gt;O, 244-245°C dec.</td>
<td>2-methyl chloroformate IPA</td>
</tr>
<tr>
<td>37</td>
<td>-CH&lt;sub&gt;2&lt;/sub&gt;CH&lt;sub&gt;3&lt;/sub&gt;</td>
<td>HCl 0.5 H&lt;sub&gt;2&lt;/sub&gt;O, 278-279°C</td>
<td>Ethyl chloroformate IPA</td>
</tr>
<tr>
<td>38</td>
<td>F</td>
<td>HCl, 285°C</td>
<td>p-Fluorophenyl chloroformate, MeOH</td>
</tr>
<tr>
<td>39</td>
<td>-CH&lt;sub&gt;2&lt;/sub&gt;</td>
<td>HCl 1.5 H&lt;sub&gt;2&lt;/sub&gt;O, 204-206°C dec.</td>
<td>Benzyl chloroformate, H&lt;sub&gt;2&lt;/sub&gt;O</td>
</tr>
</tbody>
</table>

(1) Prepared in situ. (2) Formed in situ.
<table>
<thead>
<tr>
<th>Example No.</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

(1) Carry out analysis as per above; results to be reported.
EXAMPLE 40

2-Methylallyl 4-([4-amino-6,7-dimethoxyquinolin-2-yl]piperazine-1-carboxylate (0.21 g) was added to a stirred solution of concentrated sulphuric acid (2 ml) and H$_2$O (2 ml) at 10-15° and stirring maintained at 10-15° for 3 hours. The reaction mixture was basified with sodium hydroxide solution (5N) whilst maintaining temperature below 15° and then extracted with methylene chloride. The combined extracts were washed with water, dried (MgSO$_4$) and evaporated in vacuo. Chromatography on silica (Merck 9385, 100 g) eluting with methylene chloride/methanol (100:0→85:15) followed by treatment of the product with ethereal hydrogen chloride and recrystallisation from isopropanol gave 2-methyl-2-hydroxypropyl 4-([4-amino-6,7-dimethoxyquinolin-2-yl]piperazine-1-carboxylate hydrochloride hemihydrate (0.05 g), m.p. 280°.

Analysis %:-

Found: C,53.6; H,6.6; N,12.7

Calculated for C$_{20}$H$_{28}$N$_{4}$O$_{5}$·HCl·0.5H$_2$O: C,53.4; H,6.7; N,12.5.

EXAMPLE 41

H$_2$ Pd/C

PLC 351c
4-Amino-6,7-dimethoxy-2(4-benzylpiperazin-1-yl)quinoline (6.2 g) in ethanol (300 ml) with 5% Pd/C catalyst was stirred at 50° under an atmosphere of hydrogen (50 p.s.i.) for 20 hours. The mixture was cooled, chloroform (100 ml) added and the solution filtered through "Solkafloc". The solid was washed with chloroform-methanol (1:1, 4 x 100 ml) and the combined filtrates evaporated in vacuo. The residue was partitioned between chloroform-sodium carbonate solution (10%), the organic layer removed, the aqueous phase saturated with salt and further extracted with chloroform. The combined organic extracts were washed with brine, dried (Na₂SO₄) and evaporated in vacuo to yield 4-amino-6,7-dimethoxy-2-(piperazin-1-yl)quinoline (2.42 g).

Spectroscopy showed this product to be the same as that of Example 32.

The following Preparations illustrate the preparation of certain starting materials.

**Preparation 1**

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{NH}_2 \\
\text{CH}_3 & \quad \text{CN}
\end{align*}
\]

\[
\text{(CH}_3\text{)}_2\text{NCOCH}_3/\text{POCl}_3
\]

\[
\begin{align*}
\text{CH}_3\text{O} & \quad \text{N} \\
\text{CH}_3 & \quad \text{CH}_3
\end{align*}
\]
Phosphorous oxychloride (1.0 ml) was added to a stirred solution of dimethylacetamide (2.8 ml) in chloroform (10 ml) at room temperature. The mixture was stirred for 5 minutes, 2-cyano-4,5-dimethoxyaniline (1.78 g) added and the reaction stirred under reflux for 4 hours. The mixture was cooled, poured onto ice and extracted with chloroform and the organic phase discarded. The aqueous layer was basified (solid NaOH) extracted with chloroform, the combined extracts washed with water, dried (Na₂SO₄) and evaporated in vacuo. A sample of the brown oily residue (2 g) was crystallised from diisopropyl ether to give N,N-dimethyl-N'-(2-cyano-4,5-dimethoxyphenyl)acetamidine, m.p. 94-96°.

Analysis:

Found: C, 63.3; H, 6.9; N, 17.2
Calculated for C₁₃H₁₇N₃O₂: C, 63.1; H, 6.9; N, 17.0.

The following compounds were prepared by the same general method as Preparation 1, starting from the appropriate acetyl derivative of the formula R.COCH₃. In Preparation 2 the crude product was purified by column chromatography.
<table>
<thead>
<tr>
<th>Preparation No.</th>
<th><strong>R</strong></th>
<th>Form Isolated m.p.</th>
<th>Molecular Formula</th>
<th>Analysis % (Theoretical in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><img src="https://via.placeholder.com/15" alt="Image" /></td>
<td>crude</td>
<td></td>
<td>Characterised by spectroscopy</td>
</tr>
<tr>
<td>3</td>
<td><img src="https://via.placeholder.com/15" alt="Image" /></td>
<td>free base 108-109°</td>
<td>$C_{21}H_{24}N_4O_2$</td>
<td>69.2 6.7 15.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(69.2 6.6 15.4)</td>
</tr>
<tr>
<td>4</td>
<td><img src="https://via.placeholder.com/15" alt="Image" /></td>
<td>free base 136-138°</td>
<td>$C_{17}H_{19}N_4O_3F_3$</td>
<td>52.9 4.9 14.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(53.1 5.0 14.6)</td>
</tr>
<tr>
<td>5</td>
<td><img src="https://via.placeholder.com/15" alt="Image" /></td>
<td>free base 143-145°</td>
<td>$C_{22}H_{25}N_3O_4$</td>
<td>66.0 6.3 10.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(66.8 6.4 10.6)</td>
</tr>
<tr>
<td>Preparation No.</td>
<td>R</td>
<td>Form Isolated m.p.</td>
<td>Molecule Formal</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>------------</td>
<td>--------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-N[8]</td>
<td>crude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-N[8]-C₆H₅</td>
<td>free base 108-109⁰</td>
<td>C₂₁H₂₄N₂</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-N[8]COCP₃</td>
<td>free base 136-138⁰</td>
<td>C₁₇H₁₉N₂O₂</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-N[8]OCH₃</td>
<td>free base 143-145⁰</td>
<td>C₂₂H₂₅N₂O₂</td>
<td></td>
</tr>
</tbody>
</table>

Note: The chemical structure is represented in the image.
Analysis Z  
(Theoretical in brackets)  

<table>
<thead>
<tr>
<th>C</th>
<th>H</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterised by spectroscopy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69.2</td>
<td>6.7</td>
<td>15.3</td>
</tr>
<tr>
<td>(69.2</td>
<td>6.6</td>
<td>15.4)</td>
</tr>
<tr>
<td>52.9</td>
<td>4.9</td>
<td>14.7</td>
</tr>
<tr>
<td>(53.1</td>
<td>5.0</td>
<td>14.6)</td>
</tr>
<tr>
<td>66.0</td>
<td>6.3</td>
<td>10.5</td>
</tr>
<tr>
<td>(66.8</td>
<td>6.4</td>
<td>10.6)</td>
</tr>
</tbody>
</table>
Preparation 6

A solution of N-[1-(4-trifluoroacetethylpiperazin-1-yl)ethylidene]-2-cyano-4,5-dimethoxyaniline (29.5 g) in methanol (400 ml) and sodium hydroxide (2N, 100 ml) was stirred at room temperature for 3 hours. The mixture was then evaporated in vacuo, the residue taken up in chloroform (350 ml) washed with water and dried (Na₂SO₄). The solution was evaporated in vacuo and the crude N-(1-[piperazin-1-yl]ethylidene)-2-cyano-4,5-dimethoxyaniline (23 g), used without further purification.

Preparation 7
reccrystalised from methanol to give 4-aino-6,7-dimethoxy-2(4-
benzylpiperazin-1-yl)quinoline dihydrochloride sesquihydrate, m.p.
260°-263°.

P LC 351C

- 41 -

2-Cyano-4,5-dimethoxyaniline (20 g), a trace of the
 corresponding hydrogen chloride salt (200 mg) and
 triethylorthacetate (40 ml) were stirred at 150° for 1 hour, with
 removal of ethanol by distillation. The mixture was then
 evaporated in vacuo and the crude residue of ethyl
 N-(2-cyano-4,5-dimethoxyphenyl)acetimidate (27.95 g) used
directly.

Preparation 3

The crude product (26.9 g) from the previous Preparation,
N-benzylpiperazine (21 g) and p-toluenesulphonic acid (100 mg)
were stirred together at 150° for 2 hours under a slight pressure
reduction. On cooling, the residue was taken up in methylene
chloride and extracted with dilute hydrochloric acid (2N, 2 x 200
ml). The acid layer was adjusted to pH4 (5N NaOH), extracted with
methylen chloride (2 x 200 ml) and the combined extracts
discarded. The aqueous phase was then basified to pH9, extracted
with methylene chloride (3 x 200 ml), the combined extracts washed
with brine, dried (Na₂SO₄) and evaporated in vacuo. The residue
was purified by column chromatography (Merck 9385 silica, 400 g)
eluting with methylene chloride/methanol (100:0 → 98:2) and a sample of the product (11.68 g) was taken up in ethyl acetate/methanol and treated with ethereal hydrogen chloride. The solid was treated with ether and dried to give N-[1-(4-benzylpiperazin-1-yl)ethylidene]-2-cyano-4,5-dimethoxyaniline dihydrochloride hydrate, m.p. 181-182°.

**Analysis Z:**

**Found:**

C, 56.6; H, 6.7; N, 11.9

**Calculated for C_{22}H_{26}N_{4}O_{2}HCl.H_{2}O:** C, 56.3; H, 6.4; N, 11.9.
CLAIMS

The claims:

1, 2, 3

Where:

(a) a heterocycle

(b) Cl

Substituted (C3-C E aryl, hydroxy)
The claims defining the invention are as follows:

1. A compound of the formula:

![Chemical structure diagram]

or a pharmaceutically acceptable acid addition salt thereof, wherein R is \(-\text{N}(\text{C}_1-\text{C}_4 \text{ alkyl})_2\), piperidino, 6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl or a group of the formula

\[ N-Y \]

where Y is H, \text{C}_1-\text{C}_6 alkyl, aryl, \text{C}_1-\text{C}_4 alkyl substituted by aryl, or a nitrogen-containing aromatic heterocyclic group attached to the adjacent nitrogen atom of the piperazinyl group by a carbon atom, or Y is selected from

(a) \text{COR} where R is \text{C}_1-\text{C}_6 alkyl, \text{C}_1-\text{C}_4 alkyl substituted by aryl, \text{C}_3-\text{C}_6 cycloalkyl, (\text{C}_3-\text{C}_6 cycloalkyl)methyl, aryl, styryl or a heterocyclic group;

(b) \text{CONHR} where R is \text{C}_1-\text{C}_6 alkyl, aryl, \text{C}_1-\text{C}_4 alkyl substituted by aryl, \text{C}_2-\text{C}_4 alkenyl)methyl, \text{C}_3-\text{C}_6 cycloalkyl or (\text{C}_3-\text{C}_6 cycloalkyl)methyl; and

(c) \text{COOR} where R is \text{C}_1-\text{C}_6 alkyl, \text{C}_1-\text{C}_4 alkyl substituted by aryl, \text{C}_2-\text{C}_4 alkyl substituted other than on an \(\alpha\)-carbon atom by hydroxy, \text{C}_3-\text{C}_6 cycloalkyl, (\text{C}_3-\text{C}_6 cycloalkyl)methyl, (\text{C}_2-\text{C}_4 alkenyl)methyl, or aryl.
2. A compound according to claim 1, in which any aryl group is phenyl, naphthyl or phenyl substituted by 1 or 2 substituents each selected from halo, CF₃, C1-4 alkyl or C1-4 alkoxy or by a single methylenedioxy group.

3. A compound according to claim 1, in which R is

\[
\begin{align*}
\text{N} & \quad \text{Y} \quad \text{C}^1 \\
\text{R}^1 & \quad 2\text{-furyl, benzodioxan-2-yl, chroman-2-yl, phenyl, p-fluorophenyl, 3,4-methylenedioxyphenyl, methyl, cyclopropylmethyl, cyclopentyl, styryl, 2-naphthyl or 2-quinolyl.}
\end{align*}
\]

4. A compound according to claim 1, in which R is

\[
\begin{align*}
\text{N} & \quad \text{Y} \quad \text{C}^2 \\
\text{R}^2 & \quad \text{phenyl, cyclopropylmethyl, benzyl, n-propyl or allyl.}
\end{align*}
\]

5. A compound according to claim 1, in which R is

\[
\begin{align*}
\text{N} & \quad \text{Y} \quad \text{C}^3 \\
\text{R}^3 & \quad \text{ethyl, isobutyl,}
\end{align*}
\]

6. 4-Amino-2-[4-(2-furoyl)piperazin-1-yl]-6,7-dimethoxyquinoline and its pharmaceutically acceptable acid addition salts.

7. 4-Amino-2-[4-(1,4-benzodioxan-2-carbonyl)piperazin-1-yl]-6,7-dimethoxyquinoline and its pharmaceutically acceptable acid addition salts.
8. 4-Amino-6,7-dimethoxy-2-(6,7-dimethoxy-1,2,3,4-tetrahydroisoquinol-2-yl)quinoline and its pharmaceutically acceptable acid addition salts.

9. A pharmaceutical composition comprising a compound as claimed in any of claims 1 to 8 and a pharmaceutically acceptable carrier material.

10. A compound as claimed in claim 1, for use in treating hypertension.

11. A compound of formula (I) substantially as hereinbefore described with reference to the Examples.

DATED this FIFTH day of JULY, 1983

PFIZER CORPORATION

Patent Attorneys for the Applicant
SPURSON & FERGUSON