

NEW COMPOUNDS USEFUL FOR THE TREATMENT OF OBESITY,
TYPE II DIABETES AND CNS DISORDERS

RELATED APPLICATIONS

- 5 This application claims priority to Swedish application number 0201925-5, filed on June 20, 2002, Swedish application number 0202908-0, filed on October 1, 2002, Swedish application number 0202181-4, filed on July 11, 2002, Swedish application number 0300357-1, filed on February 10, 2003, U.S. provisional application 60/406,120, filed on August 26, 2002, U.S. provisional application 60/434,010, filed on December 17, 2002, 10 and U.S. provisional application 60/464,701, filed on April 23, 2003, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

- 15 The present invention relates to substituted sulphone and sulphonamide compounds, to pharmaceutical compositions comprising these compounds, and to the use of the compounds for the prophylaxis and treatment of medical conditions relating to obesity, type 2 diabetes, and/or disorders of the central nervous system (CNS), to achieve reduction of body weight and of body weight gain, as well as for cosmetic use.

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BACKGROUND ART

- Obesity is a condition characterized by an increase in body fat content resulting in excess body weight above accepted norms. Obesity is the most important nutritional disorder in the western world and represents a major health problem in all industrialized countries. 25 This disorder leads to increased mortality due to increased incidences of diseases such as cardiovascular disease, digestive disease, respiratory disease, cancer and type 2 diabetes. Searching for compounds, which reduce body weight has been going on for many decades. One line of research has been activation of serotonergic systems, either by direct 30 activation of serotonin receptor subtypes or by inhibiting serotonin reuptake. The exact receptor subtype profile required is however not known.

Serotonin (5-hydroxytryptamine or 5-HT), a key transmitter of the peripheral and central nervous system, modulates a wide range of physiological and pathological functions, including anxiety, sleep regulation, aggression, feeding and depression. Multiple serotonin receptor subtypes have been identified and cloned. One of these, the 5-HT₆ receptor, was
5 cloned by several groups in 1993 (Ruat, M. et al. (1993) Biochem. Biophys. Res. Commun. 193: 268-276; Sebben, M. et al. (1994) NeuroReport 5: 2553-2557). This receptor is positively coupled to adenylyl cyclase and displays affinity for antidepressants such as clozapine. Recently, the effect of 5-HT₆ antagonist and 5-HT₆ antisense oligonucleotides to reduce food intake in rats has been reported (Bentley, J.C. et al. (1999)
10 Br J Pharmac. Suppl. 126, P66; Bentley, J.C. et al. (1997) J. Psychopharmacol. Suppl. A64, 255; Woolley M.L. et al. (2001) Neuropharmacology).

Compounds with enhanced affinity and selectivity for the 5-HT₆ receptor have been identified, e.g. in WO 00/34242 and by Isaac, M. et al. (2000) *6-Bicyclopiperazinyl-1-arylsulfonylindoles and 6-Bicyclopiperidinyl-1-arylsulfonylindoles derivatives as novel,*
15 *potent and selective 5-HT₆ receptor antagonists.* Bioorganic & Medicinal Chemistry Letters 10: 1719-1721 (2000).

INFORMATION DISCLOSURE

20 J. Med. Chem. 1970, 13(4), 592-598 describes N-(4-{[2-(diethylamino)ethyl]amino}-1-naphthyl)amides; N-{5,6,7,8-Tetrahydro-4-[(3-piperidinopropyl)amino]-1-naphthyl}amides and related amides and urea derivatives as schistosomicides.
WO 99/42465 discloses sulphonamides derivatives that bind to the 5-HT₆ receptor and that
25 can be used for the treatment of CNS disorders such as anxiety, depression, epilepsy, obsessive compulsive disorders, cognitive disorders, ADHD, anorexia and bulimia schizophrenia, drug abuse.
WO 01/32646 A1 discloses compounds that bind to the 5-HT₆ receptor and that are used
for the treatment of CNS disorders and which inter alia may be used for the treatment of
30 eating disorders.

WO 99/37623 A2 discloses compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders and which inter alia may be used for the treatment of eating disorders.

5 WO 99/42465 A3 discloses compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders and which inter alia may be used for the treatment of eating disorders.

EP 0 815 861 A1 discloses compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders.

10 WO 99/02502 A2 discloses compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders and which inter alia may be used for the treatment of eating disorders.

WO 98/27081 A1 discloses compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders and which inter alia may be used for the treatment of eating disorders.

15 EP 0701819 discloses compounds that bind to the 5-HT_{1D} receptor and that are used for the treatment of CNS disorders and obesity.

US 6,191,141 and WO 01/12629 disclose compounds that bind to the 5-HT₆ receptor and that are used for the treatment of CNS disorders.

20 DISCLOSURE OF THE INVENTION

It has surprisingly been found that the compounds of formula (I) show affinity for the 5-HT₆ receptor as antagonists at low nanomolar range. Compounds according to the invention and their pharmaceutically acceptable salts have 5-HT₆ receptor antagonist, 25 agonist and partial agonist activity and are believed to be of potential use in the treatment or prophylaxis of obesity and type 2 diabetes, to achieve reduction of body weight and of body weight gain, as well as in the treatment or prophylaxis of disorders of the central nervous system such as anxiety, depression, panic attacks, memory disorders, cognitive disorders, sleep disorders, migraine, anorexia, bulimia, binge disorders, obsessive 30 compulsive disorders, psychoses, Alzheimer's disease, Parkinson's disease, Huntington's

chorea and/or schizophrenia, Attention Deficit Hyperactive Disorders (ADHD), drug abuse. The reduction of body weight and of body weight gain (e.g. treating body-weight disorders) is achieved *inter alia* by reduction of food intake. As used herein, the term “body weight disorders” refers to the disorders caused by an imbalance between energy
5 intake and energy expenditure, resulting in abnormal body (e.g., excessive) weight. Such body weight disorders include obesity.

Definitions

10 Unless otherwise stated or indicated, the term “C₁₋₆ alkyl” (or “C₂₋₆ alkenyl”) denotes a straight or branched hydrocarbon chain group having from 1 to 6 carbon atoms (or 2 to 6 carbon atoms). Examples of said lower alkyl include methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, sec-butyl, t-butyl and straight- and branched-chain pentyl and hexyl. Alkenyl groups have one or more double carbon-carbon bonds in the chain.

15 Unless otherwise stated or indicated, the term “C₁₋₆ alkoxy” denotes a straight or branched alkoxy group having from 1 to 6 carbon atoms. Examples of said lower alkoxy include methoxy, ethoxy, n-propoxy, iso-propoxy, n-butoxy, iso-butoxy, sec-butoxy, t-butoxy and straight- and branched-chain pentoxy and hexoxy.

20 Unless otherwise stated or indicated, the term “C₁₋₆ alkoxyalkyl” denotes a straight or branched alkoxyalkyl group having from 1 to 6 carbon atoms. Examples of said lower alkoxyalkyl include methoxymethyl, ethoxymethyl, iso-propoxymethyl, n-butoxymethyl, t-butoxyethyl and straight- and branched-chain pentoxymethyl.

25 The expression “C₂₋₆ alkenyl” as used herein refers to straight-chained and branched alkenyl groups containing from 2 to 6 carbon atoms. Typical examples include vinyl, allyl, 2,3-dimethylallyl, 1-butenyl groups, 1-pentenyl, and 1-hexenyl groups.

The expression "C₂₋₆ alkynyl" as used herein refers to straight-chained and branched alkynyl groups containing from 2 to 6 carbon atoms. Typical examples include ethynyl, 1-propynyl, 1-butynyl, 1-pentynyl, and 1-hexynyl groups.

- 5 Unless otherwise stated or indicated, the term "halogen" shall mean fluorine, chlorine, bromine or iodine.

The term "alkylhalide" refers to an alkyl group substituted with one or more halogen groups (e.g., F, Cl, Br, I).

10

The term "C₃₋₇ cycloalkyl" denotes a cyclic alkyl group having a ring size from C₃ to C₇, which can be saturated or partially unsaturated. Examples of said cycloalkyl include cyclopropyl, cyclobutyl, cyclopentyl, cyclopentenyl, cyclopentadienyl, cyclohexyl, methylcyclohexyl, cyclohexenyl, cyclohexadienyl, and cycloheptyl.

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The term "C₅₋₁₀ cycloalkenyl" denotes a cyclic alkenyl group having a ring size from C₅ to C₁₀. Examples of said cycloalkenyl include 1-cyclopentyl, 2-cyclopentenyl, 1-cyclohexenyl, 1-cycloheptenyl, 1-cyclooctenyl, 1-cyclononenyl, and 1-cyclodecenyl groups.

20

The term "heterocyclic" refers to a hydrocarbon ring system containing 4 to 8 ring members that have at least one heteroatom (e.g., S, N, or O) as part of the ring. It includes saturated, unsaturated, aromatic, and nonaromatic heterocycles. Suitable heterocyclic groups include thienyl, furyl, pyridyl, pyrrolidinyl, imidazolyl, pyrazolyl, piperidyl, azepinyl, morpholinyl, pyranyl, dioxanyl, pyridazinyl, pyrimidinyl, and piperazinyl groups

25

Unless otherwise stated or indicated, the term "aryl" refers to a hydrocarbon ring system having at least one aromatic ring. Examples of aryl groups include phenyl, cinnamyl, pentalenyl, indenyl, 1-naphthyl, 2-naphthyl, anthryl and phenanthryl.

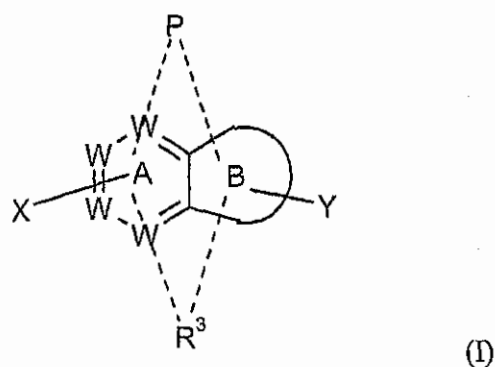
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The term "heteroaryl" refers to a hydrocarbon ring system having at least one aromatic ring which contains at least one heteroatom such as O, N, or S. Examples of heteroaryl groups include furyl, pyrrolyl, thienyl, oxazolyl, imidazolyl, thiazolyl, pyridinyl, pyrimidinyl, quinazolinyl, and indolyl groups.

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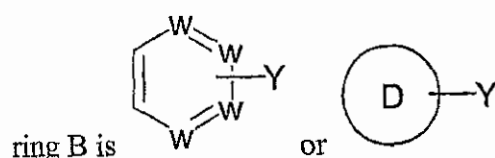
Compounds of Formula (I)

One object of the present invention is a compound having the general formula (I):



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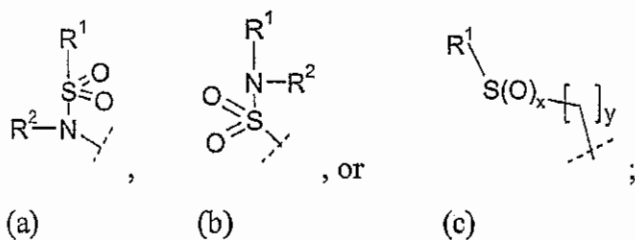
or a pharmaceutically acceptable salt thereof, wherein:



15 heteroaryl ring, said heteroaryl ring comprising one or two atoms selected from the group consisting of nitrogen, sulfur and oxygen, with the proviso that when D contains an oxygen atom, D is heteroaryl;

each W is independently -N-, -(CH)-, or -C- provided that not more than three groups W
20 are -N- in both rings A and B together;

P is any one of formula (a), (b) or (c)



wherein $x = 0, 1, \text{ or } 2$ and $y = 0, 1, \text{ or } 2$;

- and P and R^3 can be attached to any carbon atom that allows the substitution in one of either the A- or B-ring, or when ring A contains at least one nitrogen atom and P is (c),
- 5 then P can also be attached to any nitrogen in ring B that allows the substitution;

the dashed bonds denote that P and R^3 , respectively, may be attached to either the A or B ring; but each P or R^3 may not be simultaneously bound to both rings A and B;

10 R^1 is

- (a) C_{1-6} alkyl,
- (b) C_{1-6} alkoxyalkyl,
- (c) straight-chained or branched C_{1-6} hydroxyalkyl,
- (d) straight-chained or branched C_{1-6} alkylhalides,

15 (e) aryl carbonylmethyl,

- (f) C_{3-7} cycloalkyl, which is optionally partially unsaturated,
- (g) C_{3-7} cycloalkyl- C_{1-6} alkyl, wherein the cyclic ring is optionally partially unsaturated, or
- (h) a group Ar;

20 wherein Ar is

- (a) phenyl,
- (b) 1-naphthyl,
- (c) 2-naphthyl,
- (d) aryl- C_{1-6} alkyl,

25 (e) cinnamyl,

(f) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated, mono- or bi-cyclic heterocyclic ring, each containing 1 to 4 heteroatoms, selected from oxygen, sulfur, and nitrogen,

(g) a bicyclic ring system comprising at least one heterocyclic ring according to (f) and a group Ar,

wherein the group Ar is substituted in one or more positions with

(a) H, X or Y, or

(b) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated, heterocyclic ring each containing 1 to 4 heteroatoms selected from oxygen, nitrogen or sulfur;

R² is

(a) H,

(b) C₁₋₆ alkyl,

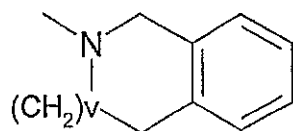
(c) C₂₋₆ alkoxyalkyl,

(d) straight or branched C₁₋₆ hydroxyalkyl, or

(e) straight or branched C₁₋₆ alkylhalides;

(f) a group Ar,

or R¹ and R² are linked to form a group -CH₂CH₂OCH₂CH₂- or



wherein v is 0-2,

X and Y are independently

(a) H,

(b) halogen,

(c) C₁₋₆ alkyl,

(d) CF₃,

(e) hydroxy,

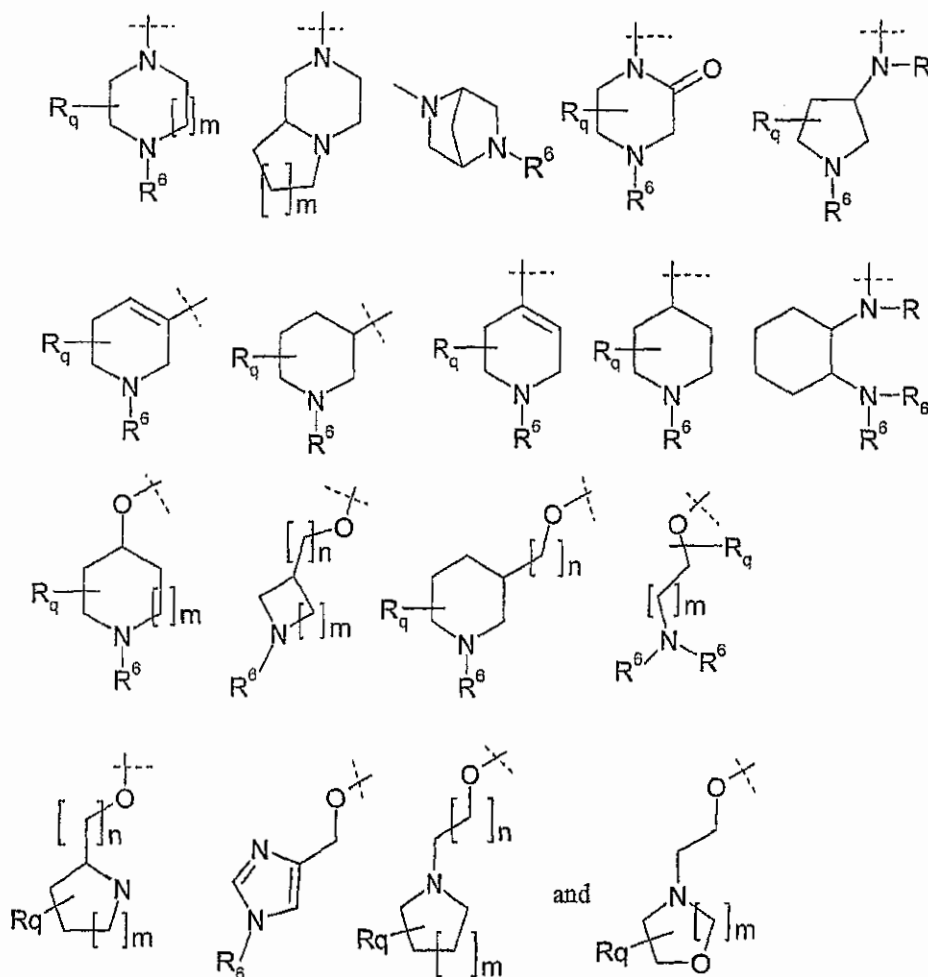
(f) C₁₋₆ alkoxy,

- (g) C₂₋₆ alkenyl,
- (h) phenyl,
- (i) phenoxy,
- (j) benzyloxy,
- 5 (k) benzoyl,
- (l) -OCF₃,
- (m) -CN,
- (n) straight or branched C₁₋₆ hydroxyalkyl,
- (o) straight or branched C₁₋₆ alkylhalides,
- 10 (p) -NH₂,
- (q) -NHR⁴,
- (r) -NR⁴R⁵,
- (s) -NO₂,
- (t) -CONR⁴R⁵,
- 15 (u) -NHSO₂R⁴,
- (v) -NR⁴COR⁵,
- (x) -SO₂NR⁴R⁵,
- (z) -C(=O)R⁴,
- (aa) -CO₂R⁴, or
- 20 (ab) -S(O)_nR⁴, wherein n is 0, 1, 2 or 3,
- (ac) -S-(C₁₋₆) alkyl, or
- (ad) -SCF₃; and

R⁴ and R⁵ are independently

- 25 (a) H,
 - (b) C₁₋₆ alkyl,
 - (c) C₃₋₇ cycloalkyl, or
 - (d) Ar, as defined above for R¹;
- alternatively, R⁴ and R⁵ are linked to form a group -CH₂OCH₂-, -CH₂CH₂OCH₂CH₂- or
- 30 (CH₂)₃₋₅;

R^3 is a group selected from any one of



5 wherein R^3 is optionally substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or (C₁₋₆) alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

10 $q = 1, 2, 3, 4, 5$ or 6 ,
 $m = 1$ or 2 , and
 $n = 0, 1$ or 2 ;

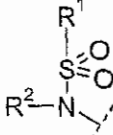
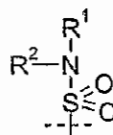
R^6 is independently

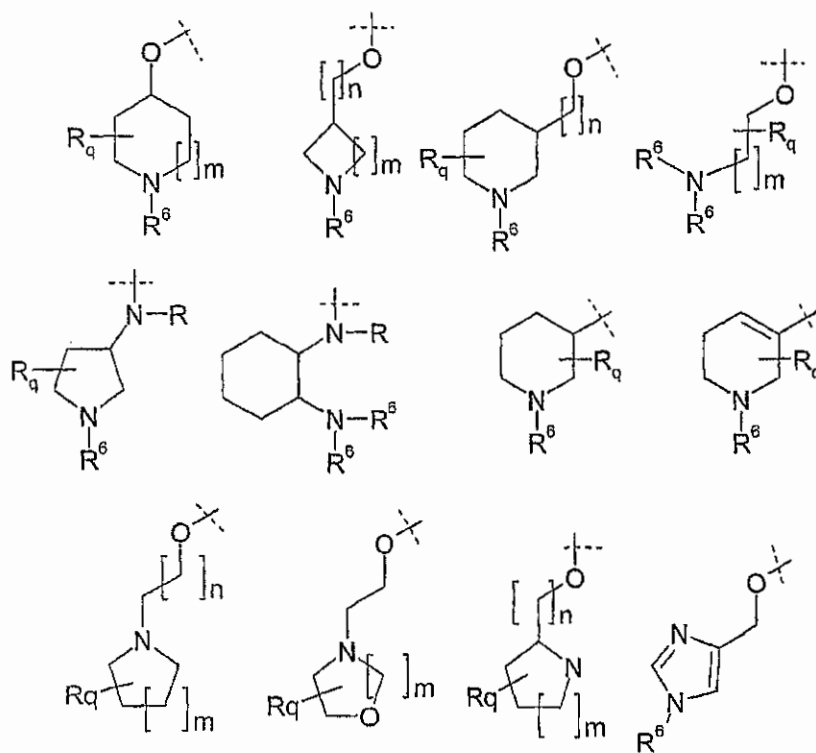
- (a) H,
- (b) linear or branched C₁₋₆ alkyl,

- (c) benzyl,
- (d) $-\text{CH}_2-\text{CH}_2-\text{OH}$, or
- (e) $-\text{CH}_2-\text{CH}_2-\text{O}-\text{C}_{1-6}$ alkyl;

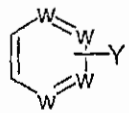
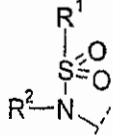
5 P and R^3 can be attached to the same ring or to different rings of rings A and B;

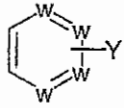
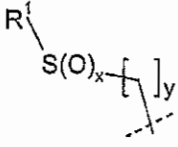
provided that

when P is  (a) or  (b), and P and R^3 both are attached to ring A in the meta- or para-position relative to one another then R^3 is selected from any one of

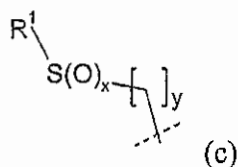


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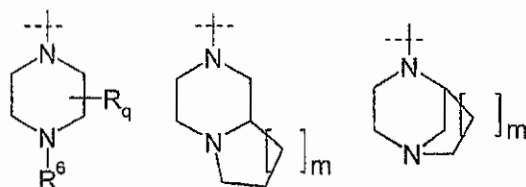
when ring B is , and P is  (a), then P and R^3 are simultaneously attached to the same ring A or B;

when ring B is , and P is , wherein y = 0, then P and R³ are attached to the different rings of rings A and B;

when the ring system A + B is benzofurane or benzothiophene, and P is

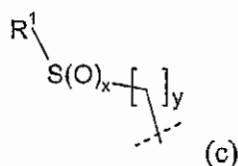


and attached to position 3 in the A+B ring system, and R³ is a group selected from any one of

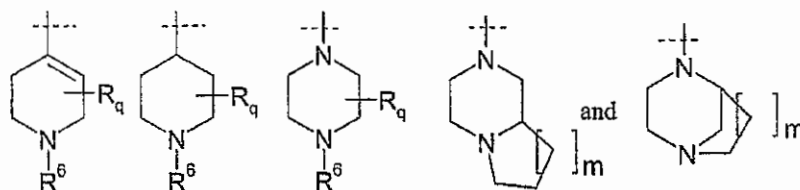


and attached to position 7 in the A+B ring system, then y = 1 or 2;

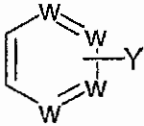
when the ring system A + B is indole, and P is



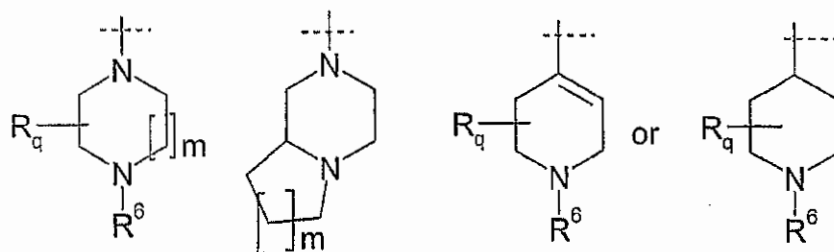
and P is attached to position 3 in the A+B ring system, and R³ is a group selected from any one of



and R³ is attached to any one of positions 5, 6 or 7 in the A+B ring system, then y = 1 or 2;
or

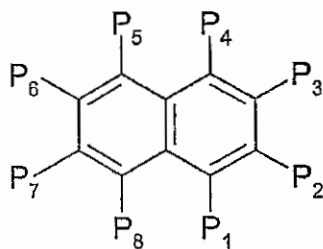
when ring B is  and $R^1 = \text{Ar}$ is partially saturated bi-cyclic heterocyclic ring containing a N atom, the N atom in Ar cannot be attached to the S atom in P; with the proviso that:

- when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, then R^3 is not substituted in position 1 on the naphthalene ring; and with the proviso that:
- when ring D is a pyrrole ring, P is of the formula (c), then R^3 is not of the formula



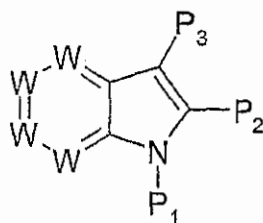
- substituted in position 3 on the pyrrole ring.

A naphthalene ring has the following position numbers:



wherein P_1 - P_8 denote the position on the naphthalene ring.

A pyrrole ring, as connected to an A ring, has the following position numbers:



wherein P₁-P₃ denote the position on the pyrrole ring.

5 It is preferred that:

R¹ is

(a) C₁₋₆ alkyl, or

(e) a group Ar;

10 Ar is

(a) phenyl,

(b) 1-naphthyl,

(c) 2-naphthyl, or

(f) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated,

15 heterocyclic ring containing 1 to 4 heteroatoms, selected from oxygen, nitrogen and sulfur, wherein the group Ar is substituted in one or more positions with

(a) H,

(b) halogen,

(c) C₁₋₆ alkyl,

20 (d) -CF₃,

(f) C₁₋₆ alkoxy,

(g) C₂₋₆ alkenyl (preferably C₂₋₄ alkenyl),

(l) -OCF₃,

(m) straight or branched C₁₋₆ hydroxyalkyl,

25 (n) phenyloxy,

(o) benzyloxy,

(v) -NR⁴COR⁵,

(x) -SO₂NR⁴R⁵,

(z) $-C(=O)R^4$,

(ab) $-S(O)_nR^4$, wherein n is 0, 1, 2 or 3;

(ac) $-S-(C_{1-6})$ alkyl, or

(ad) $-SCF_3$;

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R^2 is

(a) H, or

(b) C_{1-6} alkyl;

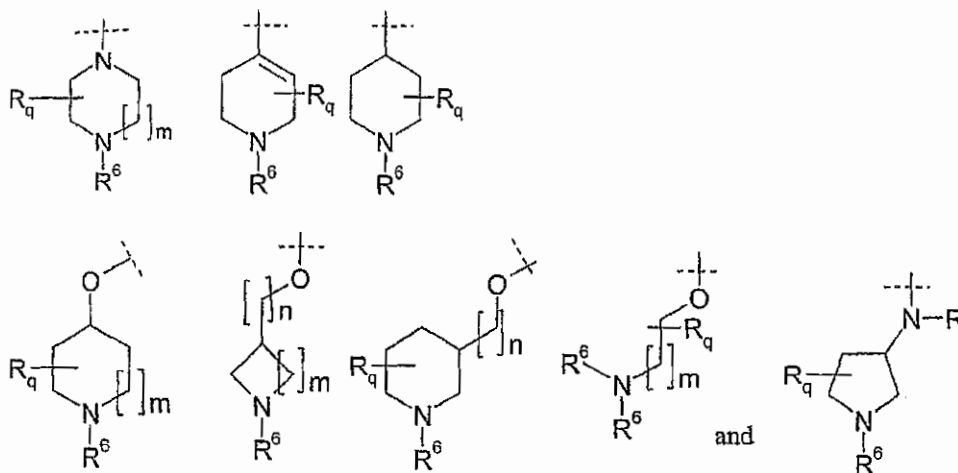
10 or R^1 and R^2 are linked to form a group $-CH_2CH_2OCH_2CH_2-$;

X and Y are H;

R^4 and R^5 are each independently H or C_{1-3} alkyl; and

15

R^3 is selected from any one of



wherein R^3 can be substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or C_{1-6} alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

$q = 1$ or 2 ,

$m = 1$ or 2 ,

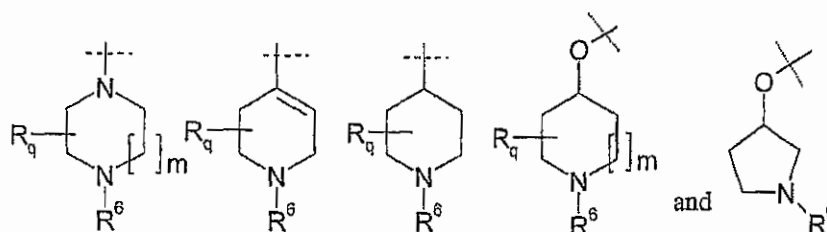
$n = 0$, and

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R^6 is independently

- (a) H,
- (b) C_{1-6} alkyl (preferably C_{1-3} alkyl), in particular methyl,
- (d) $-\text{CH}_2-\text{CH}_2-\text{OH}$, or
- (e) $-\text{CH}_2-\text{CH}_2-\text{OCH}_3$.

It is especially preferred that R^3 is selected from any one of



wherein R^3 can be substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or C_{1-2} alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

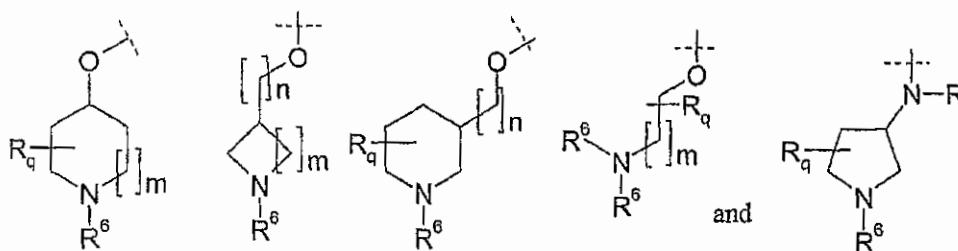
$$q = 1 \text{ or } 2,$$

$$m = 1 \text{ or } 2; \text{ and}$$

R^6 is independently

- (a) H,
- (b) C_{1-3} alkyl,
- (d) $-\text{CH}_2-\text{CH}_2-\text{OH}$, or
- (e) $-\text{CH}_2-\text{CH}_2-\text{OCH}_3$.

It is also preferred that R^3 is selected from any one of



wherein R^3 can be substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or C_{1-6} alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

$q = 1$ or 2 ,

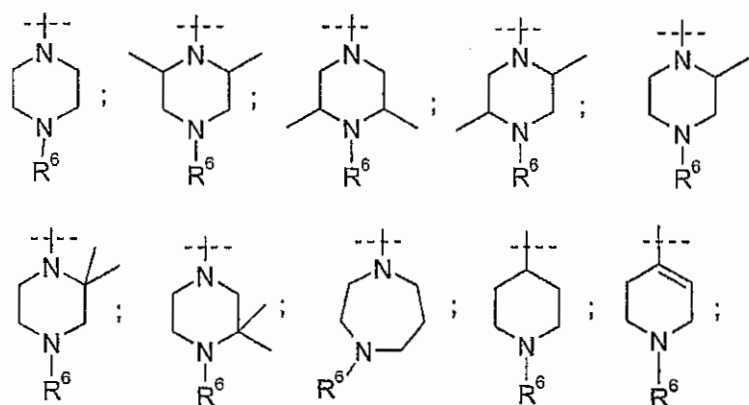
$m = 1$ or 2 ,

$n = 0$, and

R^6 is independently

- 5 (a) H,
 (b) C_{1-3} alkyl,
 (d) $-CH_2-CH_2-OH$, or
 (e) $-CH_2-CH_2-OCH_3$.

10 It is also preferred that R^3 is selected from any one of



R^6 is independently

- 15 (a) H,
 (b) C_{1-3} alkyl,
 (d) $-CH_2-CH_2-OH$, or
 (e) $-CH_2-CH_2-OCH_3$.

It is preferred that R^6 is H or methyl.

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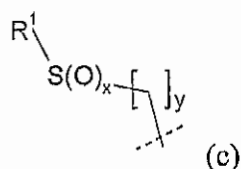
It is also preferred that R^3 is piperazine; homopiperazine; 2,6-dimethylpiperazine; 3,5-dimethylpiperazine; 2,5-dimethylpiperazine; 2-methylpiperazine; 3-methylpiperazine; 2,2-dimethylpiperazine; 3,3-dimethylpiperazine; piperidine; 1,2,3,6-tetrahydro-pyrazine; or 4-pyrrolidin-3-yloxy.

It is preferred that the groups Y and X are attached to any unsubstituted carbon atom.

It is preferred that D is pyrrolyl, thienyl or furanyl.

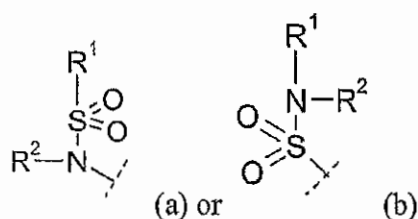
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It is preferred that P is



wherein R^1 , x, and y are as defined in claim 1.

10 It is also preferred that P is

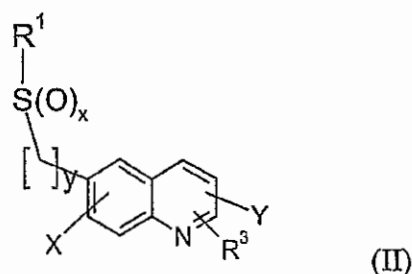


wherein R^1 and R^2 are as defined in claim 1.

It is preferred that R^2 is H.

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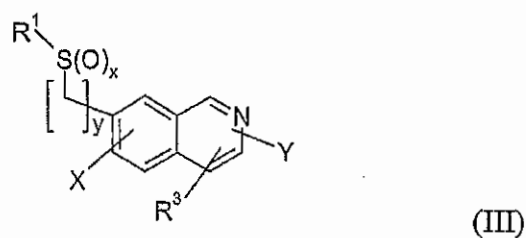
Another object of the present invention is a compound of the general formula (II)



wherein R^1 , x, y, X, and Y are as defined in claim 1, and R^3 is as defined in claim 2.

20 It is preferred that $y = 0$ and $x = 2$.

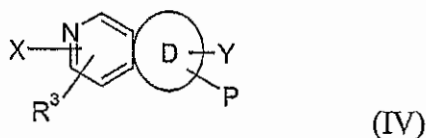
Another object of the present invention is a compound of the general formula (III)



wherein R^1 , x , y , X , and Y are as defined in claim 1, and R^3 is as defined in claim 2.

It is preferred that $y = 0$ and $x = 2$

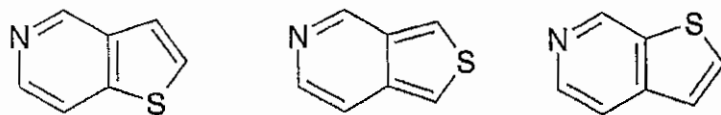
Another object of the present invention is a compound of the general formula (IV)



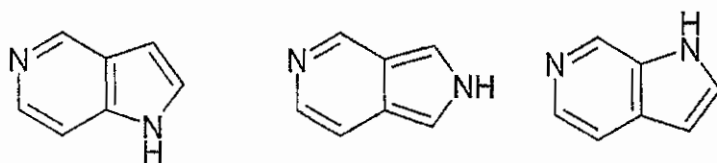
wherein P is of the formula (c), R^1 , x , y , X , and Y are as defined in claim 1, and R^3 is as defined in claim 2, and

wherein D is a five-membered heteroaryl ring, said ring comprising one or two atoms selected from the group consisting of nitrogen, sulfur and oxygen; and when the heteroaryl ring comprises one or two nitrogen atoms, a group R^6 is attached at any nitrogen atom which allows the substitution.

It is preferred that D is a thiophene and P is attached to the D ring, giving a skeleton as any of the following:

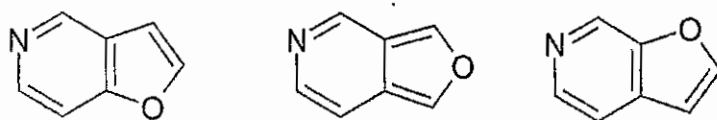


It is also preferred that D is pyrrole and P is attached to the nitrogen atom in the D ring, giving a skeleton as any of the following:

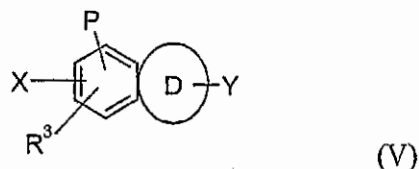


It is also preferred that D is furan and P is attached to the D ring, giving a skeleton as any of the following:

5



Another object of the present invention is a compound of the general formula (V)

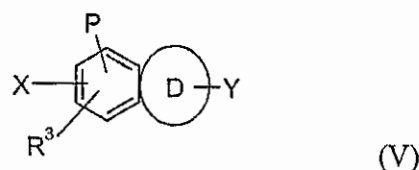


10 wherein P is of the formula (c) as defined in claim 1, R^1 , x, y, X, Y, and R^3 are as defined in claim 1, and

wherein D is a five-membered heteroaryl ring, said heteroaryl ring comprising one or two atoms selected from the group consisting of nitrogen, sulfur and oxygen; and when the heteroaryl ring comprises one or two nitrogen atoms, a group R^6 is attached at any nitrogen atom which allows the substitution.

15

Another object of the present invention is a compound of the general formula (V)

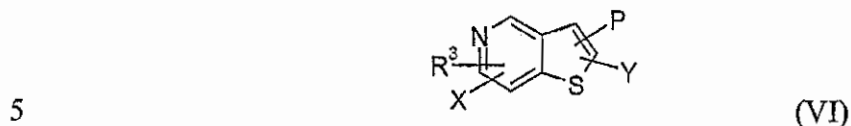


20 wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X, Y, and R^3 are as defined in claim 1, and

wherein D is a five-membered heteroaryl ring, said heteroaryl ring comprising one or two atoms selected from the group consisting of nitrogen, sulfur and oxygen; and when the

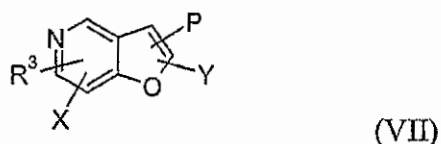
heteroaryl ring comprises one or two nitrogen atoms, a group R^6 is attached at any nitrogen atom which allows the substitution.

Another object of the present invention is a compound of the general formula (VI)



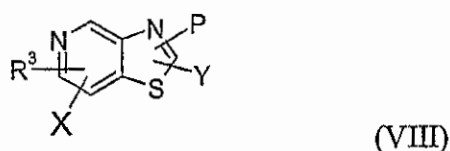
wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X and Y are as defined in claim 1, and R^3 is as defined in claim 2.

10 Another object of the present invention is a compound of the general formula (VII)



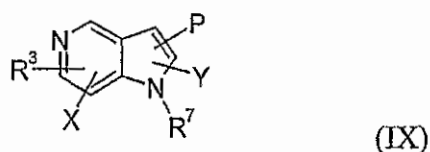
wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X and Y are as defined in claim 1, and R^3 is as defined in claim 4.

15 Another object of the present invention is a compound of the general formula (VIII)



wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X, Y, and R^3 are as defined in claim 1.

20 Another object of the present invention is a compound of the general formula (IX)



wherein R^7 in formula (IX) is:

- (a) H,
- (b) C_{1-6} alkyl,

(c) benzyl,

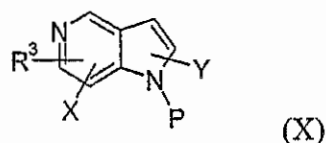
(d) $-\text{CH}_2\text{CH}_2\text{OH}$, or

(e) $\text{CH}_2\text{CH}_2\text{OCH}_3$, and

wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X,

5 Y, and R^3 are as defined in claim 1.

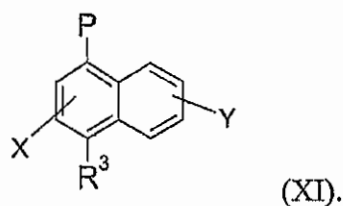
Another object of the present invention is a compound of the general formula (X)



10

wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X, Y, and R^3 are as defined in claim 1.

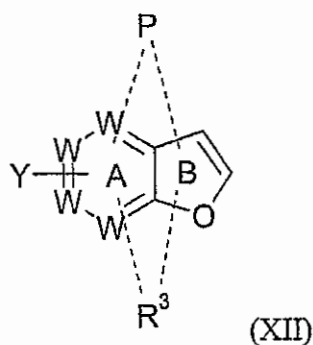
Another object of the present invention is a compound of the general formula (XI)



15

wherein P is of the formula (a) or (b) as defined in claim 1, preferably wherein R^2 is H, X and Y are as defined in claim 1, and R^3 is as defined in claim 4.

20 Another object of the present invention is a compound of the general formula (XII):



or a pharmaceutically acceptable salt thereof, wherein P and R³ are attached to the same ring or to different rings of rings A and B, wherein A, B, Y, P, and R₃ are as defined in claim 1.

5 Preferred compounds of the formula (II) are

- 6-Benzenesulfonyl-4-piperazin-1-yl-quinoline hydrochloride;
- 6-[(2-Fluorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-(1-Naphthylsulfonyl)-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 10 6-[(3,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(2-Chloro-6-methylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(2-Methyl,4-tert-butyl-phenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(3,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 15 6-[(2,3-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(4-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- 6-[(4-Isopropylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride;
- (4-Piperazin-1-yl-6-{[4-(trifluoromethyl)phenyl]sulfonyl}quinoline hydrochloride;
- 6-[(4-tert-Butylphenyl)sulfonyl]-4-(1,4-diazepan-1-yl)quinoline hydrochloride; and
- 20 4-(1,4-Diazepan-1-yl)-6-[(4-isopropylphenyl)sulfonyl]quinoline hydrochloride.

Preferred compounds of the formula (III) are

- 7-(2-Chloro-6-methyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 7-(2-*t*-Butyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 25 7-(3,4-Dichloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 7-(2,4-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 7-(2,5-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 7-(*p*-Chloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride;
- 7-Benzenesulfonyl-1-[1,4]diazepan-1-yl-isoquinoline,hydrochloride;
- 30 7-(4-tert-Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline, hydrochloride;
- 7-(2-Chloro-6-methyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;
- 7-(3,5-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;

- 7-(3,4-Dichloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;
- 7-(4-Chloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;
- 7-(3,4-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;
- 7-(2-tert-Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride;
- 5 7-Benzenesulfonyl-1-piperazin-yl-isoquinoline hydrochloride; and
- 7-(4-tert-Butyl-benzenesulfonyl-1-piperazin-yl-isoquinoline hydrochloride

Preferred compounds of the formula (IV) are

- 4-(1,4-Diazepan-1-yl)-2-(phenylsulfonyl)thieno[3,2-c]pyridine hydrochloride;
- 10 4-(1,4-Diazepan-1-yl)-2-[(3,4-dichlorophenyl)sulfonyl]thieno[3,2-c]pyridine hydrochloride;
- 4-(1,4-Diazepan-1-yl)-2-[4-tert-butylphenylsulfonyl]thieno[3,2-c]pyridine hydrochloride;
- 4-(1,4-Diazepan-1-yl)-2-[4-tert-butylphenylsulfonyl]thieno[3,2-c]pyridine hydrochloride;
- 4-(1,4-Diazepan-1-yl)-2-[3,4-dimethylphenylsulfonyl]thieno[3,2-c]pyridine hydrochloride;
- 15 2-[(4-Bromophenyl)sulfonyl]-4-(1,4-diazepan-1-yl)thieno[3,2-c]pyridine hydrochloride;
- 2-(Phenylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-(3-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride;
- 2-(4-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride;
- 4-Piperazin-1-yl-2-[[4-(trifluoromethyl)phenyl]sulfonyl]thieno[3,2-c]pyridine
- 20 hydrochloride;
- 2-[[2-tert-Butylphenyl]sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- 2-[(4-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 25 2-(1-Naphthyl sulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-[(3-Fluorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- 2-(Mesitylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-[(2-Methoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 30 2-[(2,4-Dimethoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-[(2,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
- 2-[(2,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;

- 2-[(2-Ethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 4-(Piperazinyl)-2-(3-methoxybenzyl-sulfonyl)-thienopyridine hydrochloride;
 2-(Benzylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 4-Piperazin-1-yl-2- {[4-(trifluoromethyl)benzyl]sulfonyl} thieno[3,2-c]pyridine
 5 hydrochloride;
 2-[(3-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 2-[(2,3-Difluorobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 2-[(4-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 2- {[2,5-bis(Trifluoromethyl)benzyl]sulfonyl} -4-piperazin-1-ylthieno[3,2-c]pyridine
 10 hydrochloride;
 2-[(4-Methylbenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 2- {[5-Chloro-2-(trifluoromethyl)benzyl]sulfonyl} -4-piperazin-1-ylthieno[3,2-c]pyridine
 hydrochloride;
 2-[(3,5-Dimethoxybenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 15 2-[(2-Naphthylmethyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride;
 4-Piperazin-1-yl-2- {[4-(1,2,3-thiadiazol-4-yl)benzyl]sulfonyl} thieno[3,2-c]pyridine
 hydrochloride;
 1-(4-Pyrrolidin-1-ylphenyl)-2-[(4-piperazine-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl]
 ethanone hydrochloride; and
 20 1-[4-(Diethylamino)phenyl]-2-[(4-piperazine-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl]
 ethanone hydrochloride.

Also preferred compounds of the formula (IV) are

- 1-(4-Methylphenylsulphonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride;
 25 1-(3-Chloro-2-methylphenylsulphonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine
 hydrochloride;
 1-(3,4-Dimethoxyphenylsulphonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine
 hydrochloride;
 4-(4-Piperazin-1-yl-pyrrolo[3,2-*c*]pyridine-1-sulfonyl)-benzonitrile hydrochloride;
 30 1-(4,5-Dichloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine
 hydrochloride;

- 1-(2-Chloro-4-fluorophenylsulphonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride;
- 1-Phenylmethanesulfonyl-4-piperazin-1-yl-1*H*-pyrrolo [3,2-*c*]pyridine hydrochloride;
- 1-(5-Chloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine
- 5 hydrochloride;
- 1-(4-Butyl-benzenesulfonyl)-4-piperazin-1-yl-1*H*-pyrrolo(3,2-*c*)pyridine hydrochloride;
- 1-(4-Phenoxy-benzenesulfonyl)-4-piperazin-1-yl-1*H*-pyrrolo(3,2-*c*)pyridine hydrochloride;
- 1-(Phenylsulfonyl)-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride;
- 1-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride;
- 10 1-[(4-Methoxyphenyl)sulfonyl]-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride;
- 1-[(2-Methoxy-5-methylphenyl)sulfonyl]-4-piperazin-1-yl-1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride; and
- 4-Piperazin-1-yl-1- {[2-(trifluoromethyl)phenyl]sulfonyl} -1*H*-pyrrolo[3,2-*c*]pyridine hydrochloride.
- 15
- Preferred compounds of the formula (VI) are
- N-(4-Methylphenyl)-4-(4-methylpiperazin-1-yl)thieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;
- 2-Bromo-4-(4-methyl-piperazin-1-yl)-thieno[3,2-*c*]pyridine-3-sulfonic acid *p*-tolylamide
- 20 hydrochloride;
- 4-(4-Methylpiperazin-1-yl)-*n*-phenylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-*c*]pyridine-2-sulfonic acid (3-fluoro-5-trifluoromethyl-phenyl)-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-*c*]pyridine-2-sulfonic acid (4-chloro-phenyl)-amide
- 25 hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-*c*]pyridine-2-sulfonic acid (4-isopropyl-phenyl)-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-*c*]pyridine-2-sulfonic acid *p*-tolylamide hydrochloride;
- 4-(4-Methylpiperazin-1-yl)-*N*- (2-cyclohex-1-en-1-ylethyl) thieno [3,2-*c*] pyridine-2-
- 30 sulfonamide hydrochloride;
- 2-(4-(4-Methylpiperazin-1-yl) thieno [3,2-*c*] pyridin-2-ylsulfonyl)-1,2,3,4-tetrahydroisoquinoline hydrochloride;

- 4-(4-Methylpiperazin-1-yl)-*N*-(2-thien-2-ylethyl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- 4-(4-Methylpiperazin-1-yl)-*N*-[1-(1-naphthyl) ethyl] thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- 5 4-(4-Methylpiperazin-1-yl)-*N*-(4-hexylphenyl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- N*-(3-Chlorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2-*c*] pyridine-2-sulfonamide;
- 4-(4-Methylpiperazin-1-yl)-*N*-[1-(4-fluorophenyl) ethyl] thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- 10 *N*-(2,3-Difluorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- 4-(4-Methylpiperazin-1-yl)-*N*-(4-chloro-2, 5-dimethoxyphenyl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride;
- 2-Bromo-4-(4-methylpiperazin-1-yl)-*N*-(2-cyclohex-1-en-1-ylethyl) thieno [3,2-*c*]
- 15 pyridine-3-sulfonamide hydrochloride;
- 2-Bromo-4-(4-methylpiperazin-1-yl)-*N*-[(1*S*)-1-(2-naphthyl) ethyl] thieno [3,2-*c*] pyridine-3-sulfonamide hydrochloride;
- 2-Bromo-4-(4-methylpiperazin-1-yl)-*N*-[1-(4-fluorophenyl) ethyl] thieno [3,2-*c*] pyridine-3-sulfonamide hydrochloride;
- 20 2-Bromo-4-(4-methylpiperazin-1-yl)-*N*-(2,4,5-trimethoxyphenyl) thieno [3,2-*c*] pyridine-3-sulfonamide;
- N*-(3,4-Dichlorophenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;
- N*-(2,4-Difluorophenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide
- 25 hydrochloride;
- 4-Piperazin-1-yl-*N*-[3-(trifluoromethyl)phenyl]thieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;
- N*-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;
- N*-(3,4-Dimethoxyphenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide
- 30 hydrochloride;
- N*-(4-Bromo-2-methylphenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride;

- 2-(4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonyl)-1,2,3,4-tetrahydro-isoquinoline hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2-thiophen-2-yl-ethyl)-amide hydrochloride;
- 5 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-chloro-2,5-dimethoxy-phenyl)-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid phenethyl-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2,6-diethyl-phenyl)-amide hydrochloride;
- 10 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3-phenyl-propyl)-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3,3-diphenyl-propyl)-amide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid [2-(5-methoxy-1H-indol-3-yl)-ethyl]-amide hydrochloride;
- 15 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid 4-trifluoromethyl-benzylamide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid benzyl-ethyl-amide hydrochloride;
- N-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride;
- 20 N-(4-Isopropylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride;
- N-(4-Methylphenyl)-4-(pyrrolidin-3-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- N-(4-Methylphenyl)-4-(piperidin-4-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- 25 N-(2,3-Difluorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- N-(3-Chlorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride;
- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid phenylamide hydrochloride;
- 30 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-tert-butyl-phenyl)-amide hydrochloride;

4-(4-Methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-2-sulfonic acid phenylamide hydrochloride;
 4-(4-Methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-2-sulfonic acid (3-chloro-phenyl)-amide hydrochloride;
 5 2-Bromo-4-(4-methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-3-sulfonic acid phenylamide hydrochloride;
 4-(4-Methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-3-sulfonic acid (4-methylphenyl)-amide hydrochloride; and
 N-Phenyl-7-piperazin-1-ylthieno[2,3-c]pyridine-2-sulfonamide hydrochloride.

10

Preferred compounds of the formula (VII) are
 N-(4-methylphenyl)-4-piperazin-1-ylfuro[3,2-c]pyridine-2-sulfonamide hydrochloride;
 N-phenyl-4-piperazin-1-ylfuro[3,2-c]pyridine-2-sulfonamide hydrochloride; and
 N-phenyl-7-piperazin-1-ylfuro[2,3-c]pyridine-2-sulfonamide hydrochloride.

15

A preferred compound of the formula (VIII) is
 4-Piperazin-1-yl-thiazolo[4,5-c]pyridine-2-sulfonic acid phenylamide hydrochloride.

Preferred compounds of the formula (IX) are

20 N-(4-methylphenyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine-2-sulfonamide hydrochloride;
 N-phenyl-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine-2-sulfonamide hydrochloride; and
 N-phenyl-7-piperazin-1-yl-1H-pyrrolo[2,3-c]pyridine-2-sulfonamide hydrochloride.

25 Preferred compounds of the formula (X) are

4-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;
 4-Methoxy-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;
 5-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride;
 4-Chloro-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;
 30 4-Methoxy-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;
 5-Fluoro-2-methyl-N-[4-(piperidin-4-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

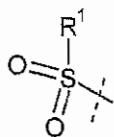
5-Chloro-N-[4-(piperidin-4-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride;
 4-Chloro-N-{4-[(3S)-pyrrolidin-3-yloxy]-1-naphthyl} benzenesulfonamide hydrochloride;
 and
 4-Chloro-N-{4-[(3R)-pyrrolidin-3-yloxy]-1-naphthyl} benzenesulfonamide hydrochloride.

5

Another object of the present invention is a process for the preparation of a compound above, said method comprising the steps of:

- (a) Mitsunobu reaction of 4-nitro-1-naphthol with boc-protected 3-hydroxypyrrolidine or 4-hydroxypiperidine;
- 10 (b) reduction of the nitro group in the nitronaphthalene obtained in step (a) to form an aminonaphthalene derivative; and
- (c) synthesis of a sulfonamide by reacting the aminonaphthalene obtained in step (b) with a suitable sulfonyl chloride.

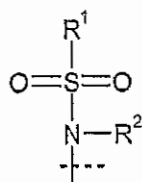
- 15 Another object of the present invention is a process for the preparation of a compound above, wherein



P is , said method comprising the steps of:

- preparation of the heteroaromatic 5-member ring fused halogen-substituted pyridine,
- reduction of an aromatic nitro group; aromatic nucleophilic substitution with a thiol via a
- 20 diazo intermediate; oxidation of the thiol derivative to a sulphone; introduction of a halogen atom by electrophilic aromatic substitution; aromatic nucleophilic substitution of the halogen with a diamine.

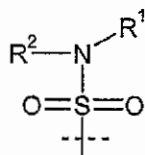
- Another object of the present invention is a process for the preparation of a compound
- 25 above, wherein



P is , said method comprising the steps of: preparation of the heteroaromatic 5-member ring fused pyridine; introduction of a carboxylic moiety; conversion of the

carboxylic moiety to amine by Curtius rearrangement; reaction of the amine group with a sulphonylchloride.

Another object of the present invention is a process for the preparation of a compound
5 above, wherein



P is , said method comprising the steps of: preparation of the heteroaromatic 5-member ring fused pyridine; introduction of sulfonylchloride moiety by nucleophilic addition; reaction of sulphonylchloride moiety with an aniline to obtained a sulfonamide; aromatic nucleophilic substitution of the chloro with a diamine.

10

All diastereomeric forms possible (pure enantiomers, tautomers, racemic mixtures and unequal mixtures of two enantiomers) are within the scope of the invention. Such compounds can also occur as cis- or trans-, E- or Z- double bond isomer forms. All isomeric forms are contemplated.

15

The compounds of the formulae (I) to (XII) may be used as such or, where appropriate, as pharmacologically acceptable salts (acid or base addition salts) thereof.

The pharmacologically acceptable addition salts as mentioned above are meant to comprise the therapeutically active non-toxic acid and base addition salt forms that the compounds
20 are able to form. Compounds that have basic properties can be converted to their pharmaceutically acceptable acid addition salts by treating the base form with an appropriate acid. Exemplary acids include inorganic acids, such as hydrogen chloride, hydrogen bromide, hydrogen iodide, sulphuric acid, phosphoric acid; and organic acids such as acetic acid, propanoic acid, hydroxyacetic acid, lactic acid, pyruvic acid, glycolic acid, maleic acid, malonic acid, oxalic acid, benzenesulphonic acid, toluenesulphonic acid, methanesulphonic acid, trifluoroacetic acid, fumaric acid, succinic acid, malic acid, tartaric acid, citric acid, salicylic acid, p-aminosalicylic acid, pamoic acid, benzoic acid, ascorbic acid and the like. Exemplary base addition salt forms are the sodium, potassium, calcium salts, and salts with pharmaceutically acceptable amines such as, for example, ammonia,
25

alkylamines, benzathine, and amino acids, such as, e.g. arginine and lysine. The term addition salt as used herein also comprises solvates which the compounds and salts thereof are able to form, such as, for example, hydrates, alcoholates and the like.

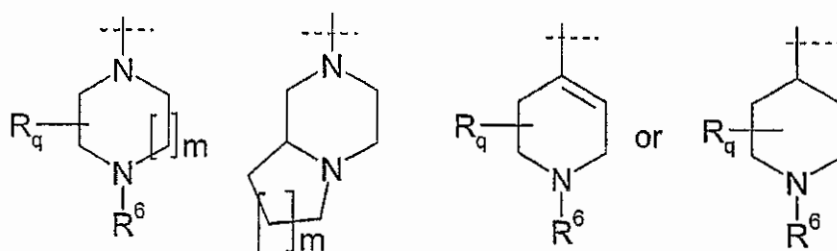
5 For clinical use, the compounds of the invention are formulated into pharmaceutical formulations for oral, rectal, parenteral or other mode of administration. Pharmaceutical formulations are usually prepared by mixing the active substance, or a pharmaceutically acceptable salt thereof, with conventional pharmaceutical excipients. The formulations can be further prepared by known
10 methods such as granulation, compression, microencapsulation, spray coating, etc. The formulations may be prepared by conventional methods in the dosage form of tablets, capsules, granules, powders, syrups, suspensions, suppositories or injections. Liquid formulations may be prepared by dissolving or suspending the active substance in water or other suitable vehicles. Tablets and granules may be
15 coated in a conventional manner.

Another object of the present invention is a compound above for use in therapy.

Another object of the present invention is a compound above, and for the case when rings
20 A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring, for use in the treatment or prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, type II diabetes, and/or disorders of the central nervous system, to achieve reduction of body weight and of body weight gain.

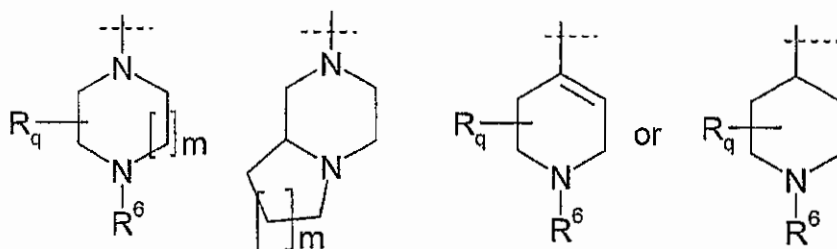
25 Another object of the present invention is a compound above for use in the treatment or prophylaxis of disorders of the central nervous system.

Another object of the present invention is a compound above, for the case when rings A
30 and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R³ is of the formula



- 5 substituted in position 3 on the pyrrole ring, for use in the treatment or prophylaxis of type II diabetes.

Another object of the present invention is a compound above, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R^3 is of the formula



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substituted in position 3 on the pyrrole ring, for use in the treatment or prophylaxis of obesity, to achieve reduction of body weight and of body weight gain.

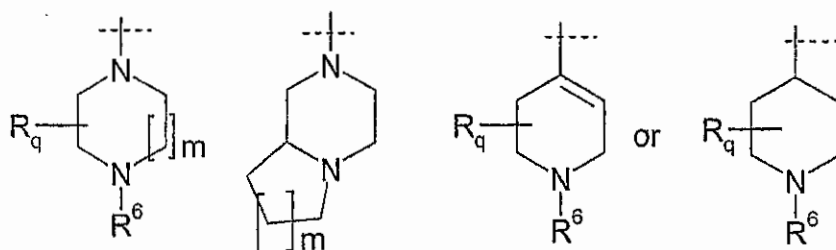
- 15 Another object of the present invention is a pharmaceutical formulation comprising a compound above as an active ingredient, in combination with a pharmaceutically acceptable diluent or carrier.

- 20 Another object of the present invention is a pharmaceutical formulation comprising a compound above, and for the case when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R^3 is substituted in position 1 on the naphthalene ring, as an active ingredient, for use in the treatment or

prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, type II diabetes, and/or disorders of the central nervous system, to achieve reduction of body weight and of body weight gain.

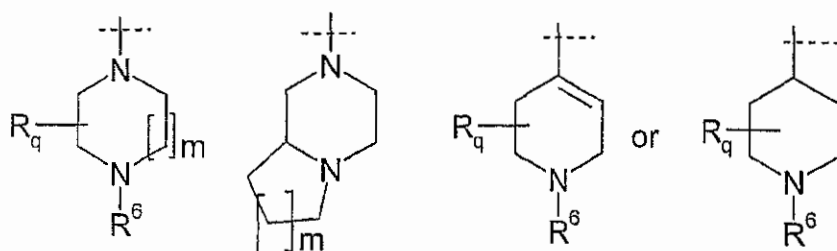
- 5 Another object of the present invention is a compound above as an active ingredient, for use in the treatment or prophylaxis of disorders of the central nervous system.

- Another object of the present invention is a pharmaceutical formulation comprising a compound above, for the case when rings A and B are both phenyl, P is any one of formula
- 10 (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R³ is of the formula



- 15 substituted in position 3 on the pyrrole ring, as an active ingredient, for use in the treatment or prophylaxis of type II diabetes.

- Another object of the present invention is a pharmaceutical formulation comprising a
- 20 compound above, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R³ is of the formula



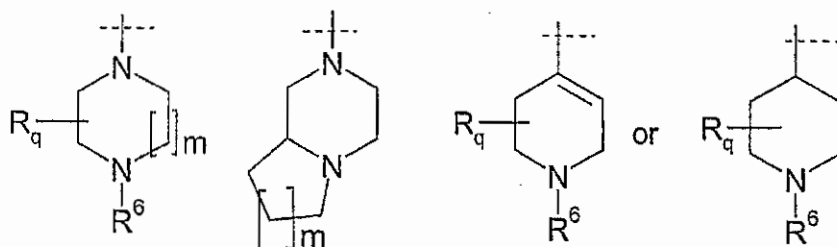
substituted in position 3 on the pyrrole ring, as an active ingredient, for use in the treatment or prophylaxis of obesity, to achieve reduction of body weight and of body weight gain.

Another object of the present invention is a method for the treatment or prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, type II diabetes, and/or disorders of the central nervous system, to achieve reduction of body weight and of body weight gain, which comprises administering to a subject (e.g., a mammal, a human, a horse, a dog, or a cat) in need of such treatment an effective amount of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, and for the case when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring.

Another object of the present invention is a method for the treatment or prophylaxis of disorders of the central nervous system, which comprises administering to a subject in need of such treatment an effective amount of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms.

Another object of the present invention is a method for the treatment or prophylaxis of type II diabetes, which comprises administering to a subject in need of such treatment an effective amount of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, for the case when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene

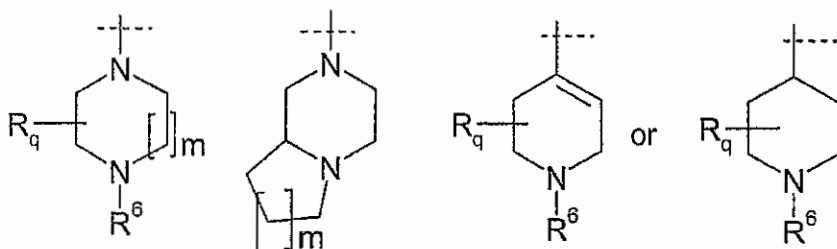
ring, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R^3 is of the formula



5

substituted in position 3 on the pyrrole ring.

Another object of the present invention is a method for the treatment or prophylaxis of obesity, which comprises administering to a subject in need of such treatment an effective
 10 amount of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R^3 is of the formula

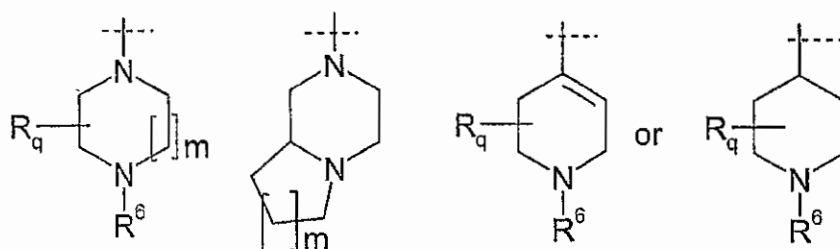


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substituted in position 3 on the pyrrole ring.

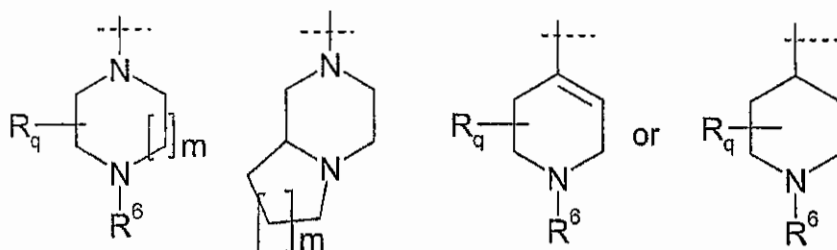
Another object of the present invention is a method for modulating 5-HT₆ receptor activity, comprising administering to a subject in need thereof an effective amount of one
 20 or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms.

- Another object of the present invention is the use of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, and for the case when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring, for the manufacture of a medicament for use in the treatment or prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, type II diabetes, and/or disorders of the central nervous system, to achieve reduction of body weight and of body weight gain.
- Another object of the present invention is the use of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms for the manufacture of a medicament for use in the treatment or prophylaxis of disorders of the central nervous system.
- Another object of the present invention is the use of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, for the case when rings A and B are both phenyl, P is any one of formula (a) or (c) substituted in position 7 on the naphthalene ring, and R³ is substituted in position 1 on the naphthalene ring, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R³ is of the formula



- substituted in position 3 on the pyrrole ring, for the manufacture of a medicament for use in the treatment or prophylaxis of type II diabetes.

Another object of the present invention is the use of one or more compounds of any of the formulae described above, their salt forms or compositions that include the compounds or their salt forms, and for the case when ring D is a pyrrole ring, P is of the formula (c) and R^3 is of the formula



substituted in position 3 on the pyrrole ring, for the manufacture of a medicament for use in the treatment or prophylaxis of obesity, to achieve reduction of body weight and of body weight gain.

10

The methods delineated herein can also include the step of identifying that the subject is in need of treatment of obesity, type II diabetes, or disorders of the central nervous system, or in need of reducing body weight and of body weight gain.

15

The invention further relates to cosmetic use of one or more compounds of any of the formulae described herein, for causing loss of weight, as well as cosmetic compositions containing said compounds.

20 Still further, the invention relates to a non-therapeutic method for improving the bodily appearance of a mammal, including a human, in which the method comprises orally administering to said mammal one or more compounds of any of the formulae described herein.

25 "An effective amount" refers to an amount of a compound that confers a therapeutic effect on the treated subject. The therapeutic effect may be objective (i.e., measurable by some test or marker) or subjective (i.e., subject gives an indication of or feels an effect).

For clinical use, the compounds of the invention are formulated into pharmaceutical formulations for oral, rectal, parenteral or other mode of administration. Usually the amount of active compounds is between 0.1-95% by weight of the preparation, preferably
5 between 0.2-20% by weight in preparations for parenteral use and preferably between 1 and 50% by weight in preparations for oral administration.

The typical daily dose of the active substance varies within a wide range and will depend on various factors such as, for example, the individual requirement of each patient and the
10 route of administration. In general, oral and parenteral dosages will be in the range of 5 to 1000 mg per day of active substance, preferably 50 to 150 mg per day.

Processes for preparation

In a further aspect the invention relates to methods of making compounds of any of the
15 formulae herein comprising reacting any one or more of the compounds of the formulae delineated herein, including any processes delineated herein. The compounds of the formulae above may be prepared by, or in analogy with, conventional methods, and especially according to or in analogy with the following methods.

20 The chemicals used in the above-described synthetic route may include, for example, solvents, reagents, catalysts, protecting group and deprotecting group reagents. The methods described above may also additionally include steps, either before or after the steps described specifically herein, to add or remove suitable protecting groups in order to ultimately allow synthesis of the compounds of any of the formulae described above, their
25 salt forms, or compositions that include the compounds or their salt forms. In addition, various synthetic steps may be performed in an alternate sequence or order to give the desired compounds. Synthetic chemistry transformations and protecting group methodologies (protection and deprotection) useful in synthesizing applicable compounds are known in the art and include, for example, those described in R. Larock,
30 *Comprehensive Organic Transformations*, VCH Publishers (1989); T.W. Greene and P.G.M. Wuts, *Protective Groups in Organic Synthesis*, 2nd Ed., John Wiley and Sons (1991); L. Fieser and M. Fieser, *Fieser and Fieser's Reagents for Organic Synthesis*, John

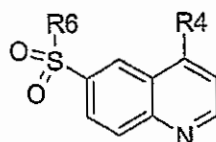
Wiley and Sons (1994); and L. Paquette, ed., *Encyclopedia of Reagents for Organic Synthesis*, John Wiley and Sons (1995) and subsequent editions thereof.

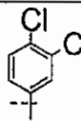
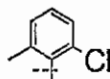
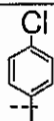
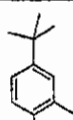
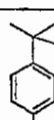
The specific examples below are to be construed as merely illustrative, and not limitative of the remainder of the disclosure in any way whatsoever. Without further elaboration, it is believed that one skilled in the art can, based on the description herein, utilize the present invention to its fullest extent. All publications cited herein are hereby incorporated by reference in their entirety.

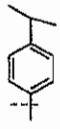
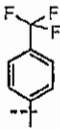
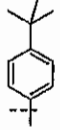
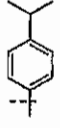
10 Methods

¹H nuclear magnetic resonance (NMR) and ¹³C NMR were recorded on a Bruker Advance DPX 400 spectrometer at 400.1 and 100.6 MHz, respectively. All spectra were recorded using residual solvent or tetramethylsilane (TMS) as internal standard. IR spectra were recorded on a Perkin-Elmer Spectrum 1000 FT-IR spectrophotometer. Ionspray mass spectrometry (MS) spectra were obtained on a Perkin-Elmer API 150EX mass spectrometer. Accurate mass measurements were performed on a Micromass LCT dual probe. Preparative HPLC/MS was performed on a Waters/Micromass Platform ZQ system equipped with System A: ACE 5 C8 column (19x50mm), eluents: MilliQ water, MeCN and MilliQ/MeCN/0.1%TFA and system B: Xterra MS C18, 5μm column (19x50mm), eluents: MilliQ water, MeCN and NH₄HCO₃ (100mM). Analytical HPLC were performed on Agilent 1100, column: ACE 3 C8 (system A) or column: YMC-Pack (system B), eluents: MilliQ/0.1%TFA and MeCN. Elemental analyses were performed on a Vario El instrument. Preparative flash chromatography was performed on Merck silica gel 60 (230-400 mesh).

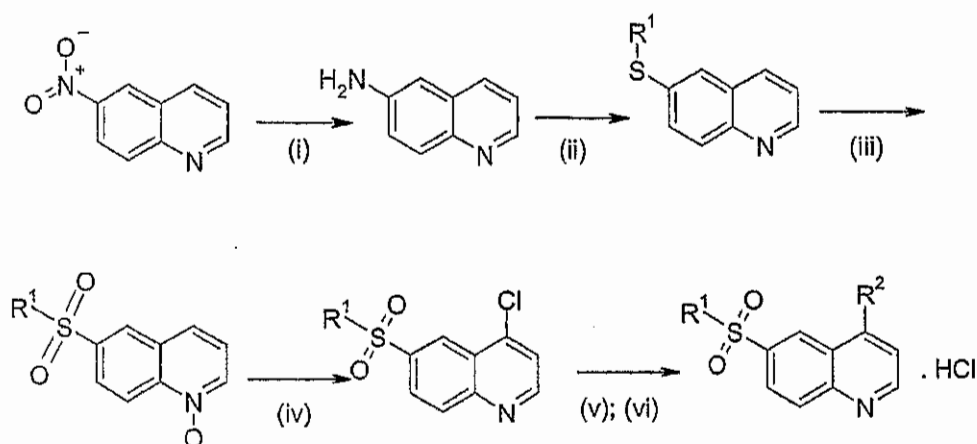
Table 1



EXAMPLE		R ⁶	R ⁴
1	6-Benzenesulfonyl-4-piperazin-1-yl-quinoline hydrochloride		
2	6-[(2-Fluorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
3	6-(1-Naphthylsulfonyl)-4-piperazin-1-ylquinoline hydrochloride		
4	6-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
5	6-[(3,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
6	6-[(2-Chloro-6-methylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
7	6-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
8	6-[(2-Methyl,4-tert-butyl-phenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
9	6-[(3,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
10	6-[(2,3-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
11	6-[(4-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		

12	6-[(4-Isopropylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride		
13	4-Piperazin-1-yl-6-[[4-(trifluoromethyl)phenyl]sulfonyl]quinoline hydrochloride		
14	6-[(4-tert-Butylphenyl)sulfonyl]-4-(1,4-diazepan-1-yl)quinoline hydrochloride		
15	4-(1,4-Diazepan-1-yl)-6-[(4-isopropylphenyl)sulfonyl]quinoline hydrochloride		

Scheme 1



- 5 **Legend to Scheme 1:** i) Hydrogen gas, Pd/C, Methanol; ii) Sodium nitrite, Sulphuric acid, diverse thiols (R¹-SH), 3h; iii) meta-chloroperoxybenzoic acid (*m*-CPBA), dichloromethane (CH₂Cl₂), overnight; iv) phosphorus oxychloride (POCl₃), acetonitrile (CH₃CN), 80 °C, 2h; v) aliphatic cyclic amines (R²), 80 °C, CH₃CN; vi) HCl in diethyl ether.

10 Methods

The assigned structures were confirmed by standard spectroscopical methods and elemental analysis and/or high resolution MS.

NMR spectra were obtained on Bruker 500 MHz or JEOL 270 MHz spectrometers at 25°C, and the chemical shift values are reported as parts per million (δ). MS spectra were acquired on a 2690 Separation Module (Waters) with a Platform LCZ (Micromass). Flash chromatography was performed on Silica gel 60 (Merck) or LiChroprep RP-18 (Merck).
5 HPLC analysis were accomplished on a HP Series1100, with a GROM-SIL 100 ODS-0 AB column, 4.6x50mm. The HPLC purifications were performed on preparative HPLC/Mass system using YMC Combi prep ODS-AQ column, 56x20 mm, Gilson pumps, Dynamax UV-1 detector and Finnigan Mass detector. The used eluents were H₂O and CH₃CN, both with 0.1% TFA. The purity of the compounds was determined by HPLC.
10 Elemental analysis was performed at Structural Chemistry Department, Biovitrum AB, Stockholm. Melting points, when given, were obtained on a Büchi or a Gallenkamp melting point apparatus and are uncorrected.

INTERMEDIATE 1

15 **Synthesis of 6-Amino-quinoline**

A suspension of 6-nitro-quinoline (8.7 g, 5 mmol), palladium on charcoal (10 %) (0.1 g) in methanol (0.2 L) was hydrogenated at room temperature for 24 with stirring. The catalyst was filtered and the solvent evaporated to yield a yellow solid. Crystallisation from ethyl acetate yielded the pure title compound as a pale yellow solid (3.3 g, 46 %). MS *m/z*: 145
20 [M+H]⁺. ¹H NMR (270 MHz, CHCl₃-d) δ ppm 3.89 (s, 2 H) 6.87 (d, *J*=2.64 Hz, 1 H) 7.14 (dd, *J*=8.97, 2.64 Hz, 1 H) 7.25 (dd, *J*=8.44, 4.22 Hz, 1 H) 7.88 (dd, *J*=7.92, 1.58 Hz, 1 H) 7.90 (d, *J*=8.97 Hz, 1 H) 8.63 (dd, *J*=4.22, 1.58 Hz, 1 H).

INTERMEDIATE 2

25 **Synthesis of 6-phenylsulfanyl-quinoline**

A solution of sodium nitrite (1 g, 14 mmol) in water (6 mL) was slowly added to a stirred solution of 6-amino-quinoline (1.44 g, 10 mmol) in sulfuric acid (50 %) (8 mL). The temperature was kept below 5 °C during the addition. The reaction mixture was poured into a solution of potassium hydroxide (9 g, 16 mmol) and thiophenol (1 mL, 9 mmol) in
30 water (30 mL). The reaction mixture was refluxed for 3 h, cooled and extracted with diethyl ether. The insoluble material was eliminated by filtration. During filtration most of the material was trapped in the solid phase. The filtrate was evaporated and the residue was

purified by column chromatography (SiO₂, ethyl acetate:hexane, 1:2) to yield a colorless oil (100 mg, 4% PS: the low yield is due to the loss of the material during the filtration procedure). MS m/z: 238 [M+H+]. ¹H NMR (270 MHz, CD₃Cl) δ ppm 7.34 (m, 4 H) 7.42 (m, 2 H) 7.57 (dd, *J*=8.97, 2.11 Hz, 1 H) 7.67 (d, *J*=2.11 Hz, 1 H) 7.99 (m, 2 H) 8.84 (dd, *J*=4.22, 1.58 Hz, 1 H).

INTERMEDIATE 3

Synthesis of 6-benzenesulfonyl-quinoline 1-oxid

A solution of m-chloroperbenzoic acid (1 g, 5.8 mmol) in DCM (10 mL) was added to a stirred solution of 6-phenylsulfanyl-quinoline (0.25 g, 1 mmol) and NaHCO₃ (0.5 g) in DCM (10 mL). The reaction was left stirring over night, washed with water, NaHCO₃ solution and evaporated. Trituration of the residue in diethyl ether gave the pure title product as a slightly yellow solid (0.14 g, 30 %). MS m/z: 287 [M+H+].

INTERMEDIATE 4

Synthesis of 6-benzenesulfonyl-4-chloro-quinoline

A solution of 6-benzenesulfonyl-quinoline 1-oxid (135 mg, 0.47 mmol) in POCl₃ (4 mL) was heated at 90 °C for 2 h after which the solution was poured on ice, ammonium hydroxide was added and extraction with DCM. The organic phase was dried (NaSO₄), the volatiles were evaporated and the residue was purified by column chromatography (SiO₂, ethyl acetate:petroleum ether, 1:1) to yield a white solid (39 mg, 27 %). MS m/z: 305 [M+H+].

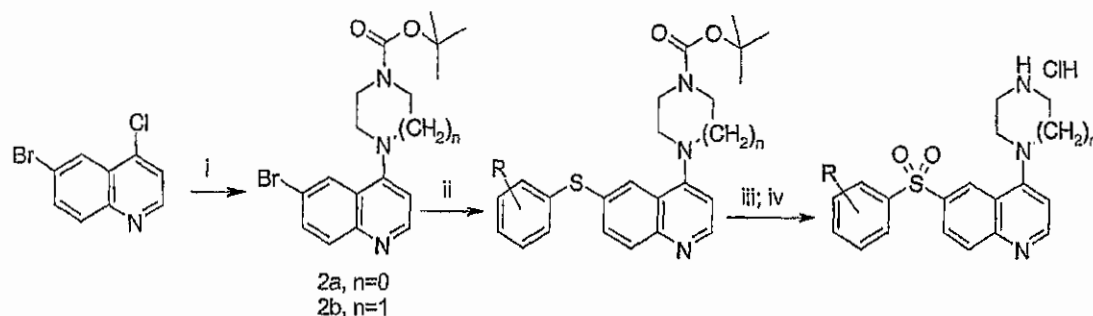
EXAMPLE 1

Synthesis of 6-benzenesulfonyl-4-piperazin-1-yl-quinoline hydrochloride

A solution of 6-benzenesulfonyl-4-chloro-quinoline (35 mg, 0.11 mmol) and piperazine (0.5 g, 2.5 mmol) in acetonitrile (2 mL) was heated at 80 °C over night. The mixture was extracted with toluene and water. The organic phase was purified by chromatography on silica gel eluted with CHCl₃ saturated with NH₃ (gas). The pure product was dissolved in ethyl acetate and HCl (gas) in diethyl ether was added. The resulting oily residue was dissolved in methanol and ethyl acetate and evaporated to yield a white solid (24 mg, 77%). MS m/z: 354 [M+H+]. ¹H NMR (270 MHz, CH₃OH-D₄) δ ppm 3.52 (m, 4 H) 4.13

(m, 4 H) 7.36 (d, $J=7.18$ Hz, 1 H) 7.57 (m, 3 H) 8.01 (m, $J=12.25$, 8.54 Hz, 3 H) 8.28 (d, $J=8.91$ Hz, 1 H) 8.63 (d, $J=6.68$ Hz, 1 H) 8.69 (s, 1 H).

Scheme 2



Legend for Scheme 2: i) NaOtBu, Pd(PPh₃)₄, n-BuOH, BOC-protected diamines; ii) *tert*-butyl piperazine-1-carboxylate or *tert*-butyl 1,4-diazepane-1-carboxylate, triethylamine or K₂CO₃, DMSO, thiols; iii; iv) TFA, H₂O₂, NaOH; iv) HCl.

10 Method A

Preparation of thiol derivatives

tert-Butyl 4-(6-bromoquinolin-4-yl)-1,4-diazepane-1-carboxylate (0.5 g, 1.23 mmol) was mixed with the thiol (1 equiv.), NaOtBu (2 equiv.), Pd(PPh₃)₄ (0.05 equiv.) and n-BuOH (5 mL) in a reaction tube. N₂ (g) was flushed through the mixture for 30 minutes. The reaction mixture was heated to 120°C overnight. The precipitate was filtrated and the reaction mixture concentrated in vacuo. The residue was dissolved in EtOAc and washed with H₂O, dried (MgSO₄) and evaporated. Purification by flash chromatography using DCM: MeOH 98:2 as eluent afforded the title product that was used in the next step without further purification.

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Method B

Oxidation of thiol derivatives to sulphone derivatives

The appropriate thiophenols derivatives are dissolved in TFA (5 mL) and stirred for 15 minutes at room temperature. H₂O₂ (2 mL) was added and the reaction was left stirring overnight. The reaction mixtures are evaporated and the residues are portioned between diethyl ether and water. The layers are separated and the water layer is extracted with diethyl ether and made basic by adding NaOH 1M. Extraction with DCM, drying with

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MgSO₄ and evaporation gives the free bases of the products which are dissolved in MeOH, excess of HCl/ether (2M) was added and the solvent evaporated. The residues are purified on preparative HPLC/MS (Xterra MS C18, 5µm column) using a 10 to 40% MeCN-water gradient (containing 0.1% HOAc) over 10 minutes. The pure fractions are pooled and lyophilised. The residues are dissolved in MeOH and treated with excess of HCl/ether (2M). After evaporation of solvent, a solid is obtained and triturated with diethyl ether giving the desired products as HCl-salts.

INTERMEDIATE 5

10 **tert-Butyl 4-(6-bromoquinolin-4-yl)piperazine-1-carboxylate**

6-Bromo-4-chloroquinoline (5.0 g, 20.6 mmol), *tert*-butyl-1-piperazine (4.1 g, 22 mmol), triethylamine (3 mL, 22 mmol) and DMSO (20 mL) were mixed and heated overnight in an oil bath at 100°C. The reaction was cooled and diluted with diethyl ether and washed with water (5x), dried (MgSO₄) and evaporated. The residue was filtered through a short column of silica (2.5-5 %) MeOH in CH₂Cl₂ and evaporated. Yield 8.02 g. (97 %). Brown liquid. HPLC 98 %, R_T=3.01 (System A1, 10-97 % MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.52 (s, 9 H) 3.12-3.17 (m, 4 H) 3.69-3.75 (m, 4 H) 6.86 (d, *J*=5.0 Hz, 1 H) 7.72 (dd, *J*=9.0, 2.26 Hz, 1 H) 7.92 (d, *J*=8.8 Hz, 1 H) 8.14 (d, *J*=2.3 Hz, 1 H) 8.73 (d, *J*=5.0 Hz, 1 H). MS (ESI+) for C₁₈H₂₂BrN₃O₂ *m/z* 392.2 (M+H⁺)

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EXAMPLE 2

6-[(2-Fluorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

A total amount of 2.25 mmol, of the appropriate thiophenol was used and the reaction was prolonged with 8 hours. The oxidation step was completed after 24 hours at ambient temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine that was additionally purified by preparative HPLC. Yield 15 mg (4 %) Yellow solid. HPLC 95 %, R_T=2.33 (System A1, 10-97 % MeCN over 3 min). ¹H NMR (400 MHz, DMSO-d₆) δ ppm 3.30-3.42 (m, 4 H) 3.51-3.62 (m, 4 H) 7.28 (d, *J*=5.27 Hz, 1 H) 7.42 (dd, *J*=10.29, 8.78 Hz, 1 H) 7.52 (t, *J*=7.28 Hz, 1 H) 7.77-7.84 (m, 1 H) 8.04-8.21 (m, 3 H) 8.62 (s, 1 H) 8.87 (d, *J*=5.27 Hz, 1 H) 9.82 (br s, 2 H). MS (ESI+) for C₁₉H₁₈FN₃O₂S *m/z* 372.0 (M+H⁺). HRMS for C₁₉H₁₈FN₃O₂S: calcd, 371.1104; found, 371.1102.

EXAMPLE 3

6-(1-Naphthylsulfonyl)-4-piperazin-1-ylquinoline hydrochloride

A total amount of 2.25 mmol, of the appropriate thiophenol was used and the reaction was prolonged with 8 hours. The oxidation step was completed after 24 hours at ambient temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine that was converted to the HCl-salt. Yield 14 mg (4 %). Grey solid. HPLC 95%, $R_T=2.54$ (System A1, 10-97% MeCN over 3 min). ^1H NMR (400 MHz, DMSO- d_6) δ ppm 3.33 (s, 4 H) 4.06 (s, 4 H) 7.38 (d, $J=6.78$ Hz, 1 H) 7.65 (d, $J=7.53$ Hz, 1 H) 7.69-7.75 (m, 1 H) 7.82 (t, $J=7.78$ Hz, 1 H) 8.12 (d, $J=8.03$ Hz, 1 H) 8.21-8.30 (m, 2 H) 8.38 (d, $J=8.03$ Hz, 1 H) 8.56 (t, $J=8.53$ Hz, 2 H) 8.74-8.79 (m, 2 H) 10.05 (s, 2 H). MS (ESI+) for $\text{C}_{23}\text{H}_{21}\text{N}_3\text{O}_2\text{S}$ m/z 404.4 ($\text{M}+\text{H}^+$) HRMS for $\text{C}_{23}\text{H}_{21}\text{N}_3\text{O}_2\text{S}$: calcd, 403.1354; found, 403.1365.

EXAMPLE 4

6-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

A total amount of 2.25 mmol, of the appropriate thiophenol was used and the reaction was prolonged with 8 hours. The oxidation step was completed after 24 hours at ambient temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine which was converted to the HCl-salt giving yellow solid. Yield 15 mg (3 %). Yellow solid. ^1H NMR (400 MHz, DMSO- d_6) δ ppm 3.35-3.41 (m, 4 H) 4.06-4.15 (m, 4 H) 7.40 (d, $J=6.78$ Hz, 1 H) 7.93 (d, $J=8.53$ Hz, 1 H) 8.04 (dd, $J=8.53$, 2.01 Hz, 1 H) 8.27 (d, $J=9.03$ Hz, 1 H) 8.32 (d, $J=2.01$ Hz, 1 H) 8.36-8.42 (m, 1 H) 8.73 (d, $J=1.51$ Hz, 1 H) 8.82 (d, $J=6.53$ Hz, 1 H) 9.86 (s, 2 H). MS (ESI+) for $\text{C}_{19}\text{H}_{17}\text{Cl}_2\text{N}_3\text{O}_2\text{S}$ m/z 422.2 ($\text{M}+\text{H}^+$). HRMS for $\text{C}_{19}\text{H}_{17}\text{Cl}_2\text{N}_3\text{O}_2\text{S}$: calcd, 421.0419; found, 421.0422. HPLC 95%, $R_T=2.69$ (System A1, 10-97 % MeCN over 3 min)

EXAMPLE 5

6-[(3,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

The oxidation step was completed after 2 hours at ambient temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine which was converted to the HCl-salt giving grey solid. Yield 0.007 g (2 %). Yellow solid. HPLC

90 %, $R_T=2.57$ (System A1, 10-97 % MeCN over 3 min). MS (ESI+) for $C_{21}H_{23}FN_3O_2S$ m/z 382.2. HRMS for $C_{21}H_{23}FN_3O_2S$: calcd, 381.1511; found, 381.1521.

EXAMPLE 6

5 **6-[(2-Chloro-6-methylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride**

A total amount of 2.25 mmol, of the appropriatethiophenol was used and the reaction was prolonged with 8 hours. Additional H_2O_2 (1 mL) was added and the reaction mixture was stirred at 50 °C for another 48 hours. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine that was converted to the HCl-salt. Yield 33
10 mg (7.5 %). White solid. 1H NMR (400 MHz, DMSO- d_6) δ ppm 2.13 (s, 3 H) 2.98 (s, 4 H) 3.72 (s, 4 H) 7.06 (d, $J=6.78$ Hz, 1 H) 7.14 (dd, $J=11.54, 8.03$ Hz, 2 H) 7.23 (t, $J=7.78$ Hz, 1 H) 7.89 (d, $J=8.78$ Hz, 1 H) 7.94-8.00 (m, 1 H) 8.24 (s, 1 H) 8.45 (d, $J=6.78$ Hz, 1 H) 9.68 (s, 2 H). MS (ESI+) for $C_{20}H_{20}ClN_3O_2S$ m/z 402.2 ($M+H^+$). HRMS for $C_{20}H_{20}ClN_3O_2S$: calcd, 401.965; found, 401.967. HPLC 95 %, $R_T=2.55$ (System A1, 10-97
15 % MeCN over 3 min).

EXAMPLE 7

6-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

A total amount of 2.25 mmol, of the appropriate thiophenol was used and the reaction was prolonged for another 8 hours. The oxidation step was completed after 24 h at ambient
20 temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine that was converted to the HCl-salt. Yield 14 mg (3 %). Yellow solid. HPLC 95 %, $R_T=2.66$ (System A1, 10-97 % MeCN over 3 min). MS (ESI+) for $C_{19}H_{18}ClN_3O_2S$ m/z 388.2 ($M+H^+$). HRMS for $C_{19}H_{18}ClN_3O_2S$: calcd, 387.0808; found,
25 387.0821.

EXAMPLE 8

6-[(2-Methyl,4-tert-butyl-phenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

The oxidation step was completed after 2 hours at ambient temperature. Purification by
30 column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine which was converted to the HCl-salt giving gray solid. Yield 17 mg (4 %). HPLC 95 %, $R_T=2.81$

(System A1, 10-97 % MeCN over 3 min). MS (ESI+) for $C_{24}H_{29}N_3O_2S$ m/z 424.2 ($M+H^+$). HRMS for $C_{24}H_{29}N_3O_2S$: calcd, 423.1980; found, 423.1969.

EXAMPLE 9

5 **6-[(3,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride**

The oxidation step was completed after 2 hours at ambient temperature. Purification by column chromatography on silica gel 10-20 % MeOH in DCM gave the free amine which was converted to the HCl-salt. Yield 33 mg (8 %). Yellow solid. 1H NMR (400 MHz, DMSO- d_6) δ ppm 2.27 (d, $J=6.27$ Hz, 6 H) 3.34 (s, 4 H) 4.12 (s, 4 H) 7.39 (dd, $J=7.40$, 10 2.13 Hz, 2 H) 7.75 (d, $J=7.78$ Hz, 1 H) 7.81 (s, 1 H) 8.32 (s, 2 H) 8.61 (s, 1 H) 8.78 (d, $J=6.78$ Hz, 1 H) 10.18 (s, 2 H). MS (ESI+) for $C_{21}H_{23}N_3O_2S$ m/z 382.2 ($M+H^+$). HRMS for $C_{21}H_{23}N_3O_2S$: calcd, 381.1511; found, 381.1519. HPLC 95 %, $R_T=2.54$ (System A1, 10-97 % MeCN over 3 min).

15 EXAMPLE 10

6-[(2,3-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

A total amount of 2.25 mmol, of the appropriate thiophenol was used and the reaction was prolonged for another 8 hours. The oxidation step was completed after 24 hours at ambient temperature. Purification by column chromatography on silica gel 10-20% MeOH in DCM 20 gave the free amine which was converted to the HCl-salt. Yield 15 mg (3 %). Yellow solid. 1H NMR (400 MHz, DMSO- d_6) δ ppm 3.36 (m, 4 H) 4.10 (m, 4 H) 7.42 (d, $J=6.78$ Hz, 1 H) 7.75 (t, $J=8.03$ Hz, 1 H) 8.07 (d, $J=8.03$ Hz, 1 H) 8.24 (d, $J=9.04$ Hz, 1 H) 8.33 (dd, $J=13.93$, 8.41 Hz, 2 H) 8.70 (s, 1 H) 8.82 (d, $J=6.78$ Hz, 1 H) 10.00 (s, 2 H). MS (ESI+) for $C_{19}H_{17}Cl_2N_3O_2S$ m/z 422.2 ($M+H^+$). HRMS for $C_{19}H_{17}Cl_2N_3O_2S$: calcd, 421.0419; 25 found, 421.0408. HPLC 95 %, $R_T=2.50$ (System A1, 10-97 % MeCN over 3 min).

EXAMPLE 11

6-[(4-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

tert-Butyl 4-{6-[(4-tert-butylphenyl)thio]quinolin-4-yl}piperazine-1-carboxylate 30 (0.60 g, 1.3 mmol) was dissolved in TFA (12 mL) and stirred for 30 minutes before H_2O_2 (0.65 mL, 6.3 mmol) was added. The mixture was stirred for 2 hours and water (5 mL) was added. The mixture was evaporated and the residue was taken up in water and washed with

diethyl ether (2x). The aqueous phase was adjusted to pH 10 with 1 N NaOH and the mixture was extracted with CH₂Cl₂ (2x), dried (MgSO₄) and evaporated. The residue was diluted with CH₂Cl₂ and 1.3 mL 2N HCl in diethyl ether was added under vigorous stirring and the mixture was evaporated and washed with diethyl ether (2 x) and dried. Yield: 0.40 g (69 %). Grey solid. HPLC 95 %, R_T=2.77 (System A1, 10-97 % MeCN over 3 min). ¹H NMR (400 MHz, DMSO-d₆) δ ppm 1.23 (s, 9 H) 3.38 (s, 4 H) 4.08 (s, 4 H) 7.39 (d, J=7.03 Hz, 1 H) 7.65 (d, J=8.53 Hz, 2 H) 7.96 (d, J=8.53 Hz, 2 H) 8.25 (d, J=8.78 Hz, 1 H) 8.30-8.36 (m, 1 H) 8.66 (d, J=1.76 Hz, 1 H) 8.81 (d, J=7.03 Hz, 1 H) 9.85 (br. s, 2 H), MS (ESI+) for C₂₃H₂₇N₃O₂S m/z 410.4 (M+H⁺).

EXAMPLE 12

6-[(4-Isopropylphenyl)sulfonyl]-4-piperazin-1-ylquinoline hydrochloride

4-Isopropylthiophenol (0.152 g, 1.0 mmol) was added dropwise to a suspension of *tert*-butyl 4-(6-bromo-quinolin-4-yl)-piperazine-1-carboxylate (0.2 g, 0.51 mmol), Na-*t*-butoxide (0.192 g, 2.0 mmol) and Pd[P(Ph)₃]₄ (0.030 g, 0.025 mmol) in ethanol (3 mL) at 90°C and the mixture was stirred for 18 h. The mixture was diluted with THF and filtered through a plug of silica and evaporated. The crude product was dissolved in TFA (5 mL) and stirred for 15 minutes before 30 % H₂O₂ (1 mL) was added. The mixture was stirred for 2 hours and evaporated. The residue was dissolved in water and washed with CH₂Cl₂ (2x) and 2 N NaOH was added until pH reached 10 and the mixture was extracted with CH₂Cl₂ (3x), dried (MgSO₄) and evaporated. The crude product was purified by preparative HPLC 5-95 water/acetonitrile collecting on m/z 395.2. After evaporation the free amine was dissolved in CH₂Cl₂ and excess of HCl in diethyl ether was added and the mixture was evaporated. Yield 0.015 g (7 %). ¹H NMR (400 MHz, DMSO-d₆) δ ppm 1.17 (d, J=7.03 Hz, 6 H) 2.90-3.02 (m, 1 H) 3.34-3.42 (m, 4 H) 4.03-4.12 (m, 4 H) 7.39 (d, J=6.78 Hz, 1 H) 7.51 (d, J=8.28 Hz, 2 H) 7.96 (d, J=8.53 Hz, 2 H) 8.26 (d, J=9.03 Hz, 1 H) 8.29-8.36 (m, 1 H) 8.66 (s, 1 H) 8.80 (d, J=6.78 Hz, 1 H) 9.85-9.97 (m, 2 H). HPLC 95%, R_T=2.65 (System A1, 10-97% MeCN over 3 min).

EXAMPLE 13

4-Piperazin-1-yl-6-[[4-(trifluoromethyl)phenyl]sulfonyl]quinoline hydrochloride

4-Trifluoromethylthiophenol (0.178 g, 1.0 mmol) was added dropwise to a suspension of *tert*-butyl 4-(6-bromo-quinolin-4-yl)-piperazine-1-carboxylate (0.2 g, 0.51 mmol), Sodium-*t*-butoxide (0.192 g, 2.0 mmol) and Pd[P(Ph)₃]₄ (0.030 g, 0.025 mmol) in ethanol (3 mL) at 90°C and the mixture was stirred for 18h. The mixture was diluted with THF and filtered
5 through a plug of silica and evaporated. The crude product was dissolved in TFA (5 mL) and stirred for 15 minutes before 30 % H₂O₂ (1 mL) was added. The mixture was stirred for 2 hours and evaporated. The residue was dissolved in water and washed with CH₂Cl₂ (2x) and 2 N NaOH was added until pH reached 10 and the mixture was extracted with CH₂Cl₂ (3x) dried (MgSO₄) and evaporated. The crude was purified by preparative HPLC
10 5-95 water/acetonitrile collecting on m/z 421.1. After evaporation the free amine was dissolved in CH₂Cl₂ and excess of HCl in diethyl ether was added and the mixture was evaporated. Yield 0.024 g (10%). ¹H NMR (400 MHz, DMSO-d₆) δ ppm 3.33-3.40 (m, 4 H) 4.13-4.21 (m, 4 H) 7.42 (d, *J*=7.03 Hz, 1 H) 8.02 (d, *J*=8.53 Hz, 2 H) 8.25-8.35 (m, 3 H) 8.37-8.53 (m, 1 H) 8.76 (d, *J*=1.76 Hz, 1 H) 8.80 (d, *J*=7.03 Hz, 1 H) 9.95-10.05 (m, 2
15 H). Yellow oil. HPLC 95 %, R_T=2.66 (System A1, 10-97% MeCN over 3 min).

INTERMEDIATE 6

***tert*-Butyl 4-(6-bromoquinolin-4-yl)-1,4-diazepane-1-carboxylate**

6-Bromo-4-chloroquinoline (3.5 g, 14.5 mmol) was reacted with *tert*-butyl 1,4-diazepane-
20 1-carboxylate (3.7 g, 18.8 mmol) and K₂CO₃ (4 g, 29 mmol) in DMSO at 100 °C overnight. After cooling the mixture was poured into water and extracted with DCM. The organic layer was washed with water, dried (MgSO₄) and evaporated. The residue was purified by flash chromatography using a gradient of EtOAc:hexane 1:1 to 2:1 giving 2.1 g (36 %) of yellow oil. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.47 (d, *J*=5.5 Hz, 9 H) 2.08-2.16
25 (m, 2 H) 3.35-3.44 (m, 4 H) 3.60-3.73 (m, 4 H) 6.87 (d, *J*=5.5 Hz, 1 H) 7.69 (dd, *J*=9.0, 2.0 Hz, 1 H) 7.88 (d, *J*=8.5 Hz, 1 H) 8.16 (s, 1 H) 8.65 (d, *J*=5.0 Hz, 1 H). MS (ESI+) for C₁₉H₂₄BrN₃O₂ *m/z* 406.4 (M+H)⁺. HRMS (EI) calcd for C₁₉H₂₄BrN₃: 405.1052, found 405.1045.

30 INTERMEDIATE 7

tert-Butyl-4{3-[(4-tert-butylphenyl)thio]quinolin-5-yl}-1,4-diazepane-1-carboxylate
(General Method A)

The compound was prepared from tert-butyl 4-(6-bromoquinolin-4-yl)-1,4-diazepane-1-carboxylate (0.5 g, 1.23 mmol) and p-tert-butylbenzenethiol (0.2 g, 1.23 mmol). Yield: 0.27 g (44 %) of the title compound. HPLC 89 %, R_T : 3.76 min (5-99 % MeCN containing 0.1 % TFA over 3 min).

INTERMEDIATE 8

tert-Butyl-4{3-[(4-isopropylphenyl)thio]quinolin-5-yl}-1,4-diazepane-1-carboxylate
(General Method A)

The compound was prepared from tert-butyl 4-(6-bromoquinolin-4-yl)-1,4-diazepane-1-carboxylate (0.5 g, 1.23 mmol) and 4-isopropylbenzenethiol (0.19 g, 1.23 mmol). Yield: 0.27 g (46 %) of the title compound that was used in the next step without further purification. HPLC 89 %, R_T : 3.67 min (5-99 % MeCN containing 0.1 % TFA over 3 min); MS (ESI+) for $C_{28}H_{35}N_3O_2S$ m/z 478.2 ($M+H$)⁺.

EXAMPLE 14

6-[(4-tert-Butylphenyl)sulfonyl]-4-(1,4-diazepan-1-yl)quinoline hydrochloride
(General Method B)

The compound was synthesized from tert-butyl-4{3-[(4-tert-butylphenyl)thio]quinolin-5-yl}-1,4-diazepane-1-carboxylate (0.27 g, 0.55 mmol). Yield: 20 mg (8 %) of the title compound.; ¹H NMR (270 MHz, DMSO-d₆) δ ppm 1.25 (s, 9 H) 2.31 (br s, 2 H) 3.25 (br s, 2 H) 3.49 (br s, 2 H) 4.11 (br s, 2 H) 4.26 (br s, 2 H) 7.16 (d, $J=7.1$ Hz, 1 H) 7.65 (d, $J=8.2$ Hz, 2 H) 7.94 (d, $J=8.2$ Hz, 2 H) 8.19 (d, $J=8.7$ Hz, 1 H) 8.26 (d, $J=8.7$ Hz, 1 H) 8.62 (d, $J=6.3$ Hz, 1 H) 8.75 (s, 1 H) 9.65 (br s, 2 H); MS (ESI+) for $C_{24}H_{29}N_3O_2S$ m/z 424.2 ($M+H$)⁺. HPLC 93%, R_T : 2.79 min (5-99 % MeCN over 3 min).

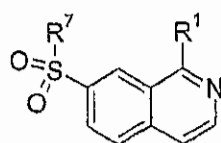
EXAMPLE 15

4-(1,4-Diazepan-1-yl)-6-[(4-isopropylphenyl)sulfonyl]quinoline hydrochloride
(General Method B)

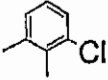
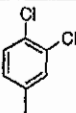
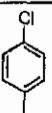
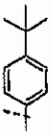
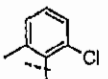
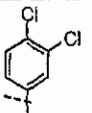
The compound was prepared from tert-Butyl-4{3-[(4-isopropylphenyl)thio]quinolin-5-yl}-1,4-diazepane-1-carboxylate (0.27 g, 0.57 mmol). Yield: 15 mg (6 %) of the title

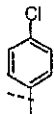
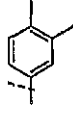
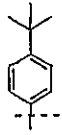
compound.; ^1H NMR (270 MHz, DMSO- d_6) δ ppm 1.16 (d, $J=6.9$ Hz, 6 H) 2.31 (br s, 2 H) 2.96 (m, 1 H) 3.25 (br s, 2 H) 3.49 (br s, 2 H) 4.11 (br s, 2 H) 4.26 (br s, 2 H) 7.16 (d, $J=6.9$ Hz, 1 H) 7.51 (d, $J=8.2$ Hz, 2 H) 7.94 (d, $J=8.2$ Hz, 2 H) 8.18 (d, $J=8.7$ Hz, 1 H) 8.30 (d, $J=8.4$ Hz, 1 H) 8.62 (d, $J=6.1$ Hz, 1 H) 8.75 (s, 1 H) 9.62 (br s, 2 H); MS (ESI+) for $\text{C}_{23}\text{H}_{27}\text{N}_3\text{O}_2\text{S}$ m/z 410.4 ($\text{M}+\text{H}$) $^+$. HPLC 93 %, R_T : 2.70 min (5-99 % MeCN over 3 min).

Table 2

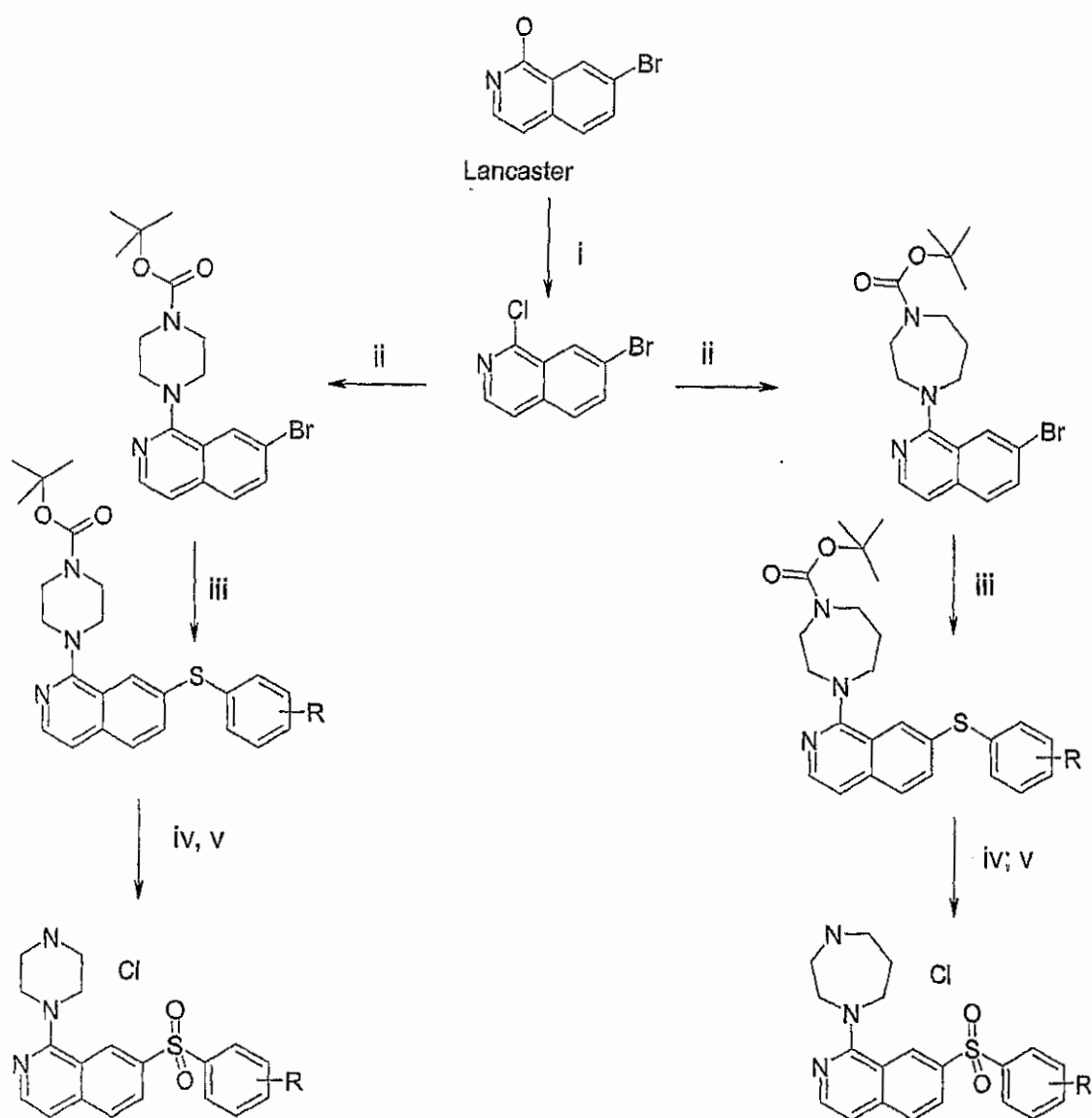


10

EXAMPLE		R ⁷	R ¹
16	7-(2-Chloro-6-methyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
17	7-(2- <i>t</i> -Butyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
18	7-(3,4-Dichloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
19	7-(3,4-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
20	7-(2,5-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
21	7-(<i>p</i> -Chloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride		
22	7-Benzenesulfonyl-1-[1,4]diazepan-1-yl-isoquinolin, hydrochloride		
23	7-(4- <i>tert</i> -Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl-isoquinoline, hydrochloride		
24	7-(2-Chloro-6-methyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		
25	7-(3,5-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		
26	7-(3,4-Dichloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		

27	7-(4-Chloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		
28	7-(3,4-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		
29	7-(2-tert-Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride		
30	7-Benzenesulfonyl-1-piperazin-yl-isoquinoline hydrochloride		
31	7-(4-tert-Butyl-benzenesulfonyl-1-piperazin-yl-isoquinoline hydrochloride		

Scheme 3



Legend to Scheme 3: i) POCl_3 ; ii) K_2CO_3 , DMF, BOC-diamines; iii) Na-BuO , thiophenols, $\text{Pd}(\text{PPh}_3)_4$; n-BuOH; iv) TFA, H_2O_2 ; v) HCl in diethyl ether.

INTERMEDIATE 9

7-Bromo-1-Chloroisoquinoline

To phosphorus oxychloride (46.6 mL, 0.5 mol) at room temperature was added, portionwise, 7-bromo-1-hydroxyisoquinoline (11.2 g, 0.05 mol). The mixture was heated to 100 °C for 90 min with rapid stirring. On cooling to room temperature, the mixture was

poured, cautiously onto ice/water (200 mL). Dropwise addition of aqueous ammonia raised the pH=8 and the resulting precipitate was collected by filtration, washing with cold water. The solid was dried under reduced vacuum at 45 °C for 12 h. 13.86 g (115 %) Beige solid isolated. ¹H NMR (DMSO-d₆) δ 8.4 (s, 1 H), 8.34-8.38 (d, J = 6 Hz, 1 H), 8.03-8.07 (m, 2 H), 7.91-7.96 (d, J = 6 Hz, 1 H); HPLC: 96%; LCMS: 242,244,246.

Nucleophilic displacement of Chlorine

INTERMEDIATE 10

10 4-(7-Bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester

To a suspension of 7-bromo-1-chloroisoquinoline (3.14 g, 13 mmol) in DMSO (20 mL) at room temperature was added either carboxylic acid *tert*-butyl (BOC)piperazine (7.23 g, 38.8 mmol) or BOC-homopiperazine (7.77 g, 38.8 mmol) and then potassium carbonate (5.36 g, 39 mmol). The mixture was heated to 110 °C for 24 h. On cooling, the mixture was poured onto ice/water (50 mL) and extracted with ethyl acetate (3 x 50 mL). The combined organic phases were washed with water 50 mL and brine (50 mL). Before drying over anhydrous sodium sulfate. Removal of solvent under reduced pressure gave crude product. Purification was performed by applying the crude material to a plug of silica in a filter funnel and eluting with heptane/ethyl acetate (2:1) and gave 2.73 g (54 %) yellow oil. ¹H NMR (CDCl₃) δ 8.20-8.22 (m, 1 H), 8.13-8.18 (d, J = 6 Hz, 1 H), 7.65-7.71 (dd, J = 12, 3 Hz, 1 H), 7.59-7.65 (d, J = 12 Hz, 1 H), 7.21-7.25 (m, 1 H), 3.64-3.73 (m, 4 H), 7.27-7.36 (m, 4 H), 1.49 (s, 9 H); LCMS: 392,394,395.

INTERMEDIATE 11

25 4-(7-Bromo-isoquinoline-1-yl)-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

2.75 g (52 %) yellow oil isolated ¹H NMR (CDCl₃) δ 8.19-8.24 (m, 1 H), 8.06-8.12 (d, J = 9 Hz, 1 H), 7.54-7.68 (m, 2 H), 7.11 (m, 1 H), 3.47-3.74 (m, 8 H), 1.98-2.16 (m, 2 H), 1.48 (s, 9 H); LCMS: 406,407,408.

30 Palladium-catalysed aryl thiol coupling

To 7-bromo-1-chloroisoquinoline (1 mmol) in butan-1-ol (20 mL) at room temperature was added sodium *tert*-butoxide (481 mg, 5 mmol), thiol (1.5 mmol) and tetrakis

triphenylphosphine palladium (60 mg, catalytic). The mixture was heated to 120 °C for 16 h. On cooling to room temperature, the mixture was filtered through silica eluting with THF. Removal of solvent under reduced pressure gave the crude product which was used without further purification in the subsequent step.

5

INTERMEDIATE 12

4-[7-(2-Chloro-6-methyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester

10 A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), 2-chloro-6-methyl-thiophenol (0.206 g, 1.3 mmol), Na^tBuO (0.44 g, 4.5 mmol), Pd(PPh₃)₄ (74 mg, 0.065 mmol) in nBuOH (10 mL) was heated at 110 °C, 3h. The reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by
15 flash column chromatography (SiO₂, n-heptane: ethyl acetate 8:2) to give 530 mg of the title compound as colourless oil (yield 86.4 %). ¹H NMR (CDCl₃) δ 8.05 (d, 1H), 7.65 (d, 1H), 7.20-7.45 (m, 5H), 7.15 (d, 1H), 3.26-3.40 (m, 4H), 3.10-3.20 (m, 4H), 2.5 (s, 3H), 1.38 (s, 9H).

20 INTERMEDIATE 13

4-[7-(2-*t*-butyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester

A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), 2-*t*-butyl-thiophenol (0.216 g, 1.3 mmol), Na^t-BuO (0.44 g, 4.5 mmol),
25 Pd(PPh₃)₄ (74 mg, 0.065 mmol) in n-BuOH (10 mL) was heated at 110 °C, 3h. The reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by flash column chromatography (SiO₂, n-heptane: ethyl acetate 8:2) to give 440 mg of the
30 title compound as colorless oil (yield 71 %). ¹H NMR (CDCl₃) δ 8.00-8.10 (m, 2H), 7.15-

7.65 (m, 7H), 3.60-3.70 (m, 1H), 3.30-3.45 (m, 4H), 3.05-3.20 (m, 3H), 1.55 (s, 9H), 1.50 (s, 9H).

INTERMEDIATE 14

5 **4-[7-(3,4-Dichloro-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester**

A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), 3,4-dichloro-thiophenol (165 μ L, 1.3 mmol), Na^tBuO (0.44 g, 4.5 mmol), Pd(PPh₃)₄ (74 mg, 0.065 mmol) in *n*-BuOH (10 mL) was heated at 110 °C, 3h. The
10 reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by flash column chromatography (SiO₂, *n*-pentane:ethyl acetate 9.5:0.5→8:2) to give 230 mg of the title compound as colorless oil (yield 36 %). ¹H NMR (CDCl₃) δ 8.10-8.20 (m, 2H),
15 7.90 (bs, 1H), 7.65-7.75 (m, 2H), 7.10-7.55 (m, 3H), 3.50-3.65 (m, 4H), 3.20-3.30 (m, 4H), 1.50 (s, 9H).

INTERMEDIATE 15

20 **4-[7-(3,4-Dimethyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester**

A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), 3,4-dimethyl-thiophenol (175 μ L, 1.3 mmol), Na^tBuO (0.44 g, 4.5 mmol), Pd(PPh₃)₄ (74 mg, 0.065 mmol) in *n*-BuOH (10 mL) was heated at 110 °C, 3h. The
25 reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by flash column chromatography (SiO₂, *n*-pentane:ethyl acetate 9.5:0.5→8:2) to give 260 mg of the title compound as colorless oil (yield 44 %). ¹H NMR (CDCl₃) δ 8.00-8.10 (m, 2H),
7.55-7.65 (m, 3H), 7.40-7.50 (m, 1H), 7.10-7.30 (m, 2H), 3.30-3.40 (m, 4H), 3.10-3.20 (m,
30 4H), 2.30 (s, 3H), 2.25 (s, 3H), 1.50 (s, 9H).

INTERMEDIATE 16

4-[7-(3,5-Dimethyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester

A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), 3,5-dimethyl-thiophenol (180 mg, 1.3 mmol), Na₂BuO (0.44 g, 4.5 mmol), Pd(PPh₃)₄ (74 mg, 0.065 mmol) in nBuOH (10 mL) was heated at 110 °C, 3h. The reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by flash column chromatography (SiO₂, n-pentane:ethyl acetate 9.8:0.2→8:2) to give 380 mg of the title compound as colourless oil (yield 65 %). ¹H NMR (CDCl₃) δ 8.05-8.10 (m, 1H), 7.80-7.85 (m, 1H), 7.60-7.75 (m, 1H), 7.17-7.25 (m, 1H), 7.10 (bs, 2H), 7.00 (bs, 1H), 3.40-3.50 (m, 4H), 3.10-3.20 (m, 4H), 2.25 (bs, 6H), 1.50 (s, 9H).

INTERMEDIATE 17

4-[7-(*p*-Chloro-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester

A mixture of 4-(7-bromo-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester (0.5 g, 1.3 mmol), *p*-chloro-thiophenol (188 mg, 1.3 mmol), Na₂BuO (0.44 g, 4.5 mmol), Pd(PPh₃)₄ (74 mg, 0.065 mmol) in nBuOH (10 mL) was heated at 110 °C, 3h. The reaction mixture was filtered. The filtrate was concentrated and the residue was dissolved in ethyl acetate. The organic phase was washed with water (50 mL x 3), separated and dried (MgSO₄), filtered. The volatiles were evaporated and the residue was purified by flash column chromatography (SiO₂, n-pentane:ethyl acetate 9.5:0.5 → 8:2) to give 300 mg of the title compound as colourless oil (yield 50 %). ¹H NMR (CDCl₃) δ 8.05-8.15 (m, 2H), 7.60-7.70 (m, 2H), 7.40-7.50 (m, 2H), 7.15-7.30 (m, 3H), 3.45-3.55 (m, 4H), 3.10-3.15 (m, 4H), 1.50 (s, 9H).

INTERMEDIATE 18

4-(7-Phenylsulfanyl-isoquinoline-1-yl)-piperazine-1-carboxylic acid, *tert*-butyl ester

LCMS: 422,423.

5 INTERMEDIATE 19

4-[7-(4-*tert*-Butyl-phenylsulfanyl)-isoquinoline-1-yl]-piperazine-1-carboxylic acid, *tert*-butyl ester

LCMS: 478,479.

10 INTERMEDIATE 20

4-(7-Phenylsulfanyl-isoquinoline-1-yl)-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

MS: 368,369,370.

15 INTERMEDIATE 21

4-[7-(4-*tert*-Butyl-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

MS: 424,425,426.

20 INTERMEDIATE 22

4-[7-(2-Chloro-6-methyl-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

MS: 416,417,418.

25 INTERMEDIATE 23

4-[7-(3,4-Dimethyl-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

MS: 396,397,398.

30 INTERMEDIATE 24

4-[7-(3,4-Dichloro-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid, *tert*-butyl ester

MS: 436,437438.

INTERMEDIATE 25

4-[7-(4-Chloro-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid,
5 *tert*-butyl ester

MS: 402,404.

INTERMEDIATE 26

4-[7-(3,4-Dimethyl-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic
10 acid, *tert*-butyl ester

LCMS: 464,465,466.

INTERMEDIATE 27

4-[7-(2-*tert*-Butyl-phenylsulfanyl)-isoquinoline-1-yl]-[1,4]diazepane-1-carboxylic acid,
15 *tert*-butyl ester

LCMS: 492,493,494.

BOC deprotection and oxidation of thiols to sulphone derivatives

Each thiol (0.2-1.14 mmol) was dissolved in trifluoroacetic acid (1.5 mL) at 0 °C and
20 stirred for 15 mins at this temperature. To this was added 33% aqueous hydrogen peroxide
solution (5-100 mL). The resulting mixture was stirred at room temperature for 90 min and
then treated with sodium hydroxide solution (1M, 25 mL). Extraction of this mixture with
ethyl acetate (3 x 50 mL) was followed by the washing of the combined organic layers
with brine (50mL). The organic extracts were dried over anhydrous sodium sulfate and
25 then the solvent was removed under reduced pressure. The crude product was purified by
preparative LCMS. Treatment of the purified material with HCl/Ether (1M, 1 mL) gave the
final product as a white solid.

EXAMPLE 16

30 **7-(2-Chloro-6-methyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride**

A mixture of 4-[7-(2-chloro-6-methyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-
carboxylic acid *tert*-butyl ester (160 mg, 0.340 mmol), H₂O₂ (30% in water, 200 uL),

trifluoroacetic acid (2 mL) was heated at 50 °C, 2h. A water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂, dichloromethane:methanol 8:2) to lead to 77 mg of the product compound as free base (yield 56 %). The free base was converted into hydrochloride by treatment with HCl in diethyl ether. ¹H NMR (CH₃OH-*d*₄) δ 8.88 (bs, 1H), 8.05-8.20 (m, 3H), 7.65 (d, 1H), 7.35-7.55 (m, 3H), 3.85-3.95 (m, 4H), 3.00-3.15 (m, 4H), 2.95 (s, 3H).

10 EXAMPLE 17

7-(2-*t*-Butyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride

A mixture of 4-[7-(2-*t*-butyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (273 mg, 0.571 mmol), H₂O₂ (30% in water, 1 mL), trifluoroacetic acid (3 mL) was heated at 50 °C, 2h. The reaction was continued overnight at 35 °C. A water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂, dichloromethane:methanol 8:2) to lead to 50 mg of the title compound as free base (yield 56 %). The free base was converted into hydrochloride by treatment with HCl in diethyl ether. ¹H NMR (CH₃OH-*d*₄) δ 8.55 (d, 1H), 8.25 (d, 1H), 7.95-8.10 (m, 3H), 7.55 (d, 1H), 7.55-7.65 (m, 2H), 7.4 (d, 1H), 3.60-3.75 (m, 4H), 3.40-3.50 (m, 4H), 1.55 (s, 9H).

EXAMPLE 18

7-(3,4-Dichloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride

25 A mixture of 4-[7-(3,4-dichloro-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (230 mg, 0.47 mmol), H₂O₂ (30% in water, 0.5 mL), trifluoroacetic acid (1.5 mL) was heated at 50 °C, 2h. The reaction was continued overnight at 35 °C. A water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂, dichloromethane:methanol 9:1) The free base was converted into hydrochloride by

treatment with HCl in diethyl ether to obtained 45 mg of the title compound. ¹H NMR (CH₃OH-*d*₄) δ 8.75-8.85 (m, 1H), 8.10-8.30 (m, 4H), 7.90-8.00 (m, 1H), 7.75-7.85 (m, 1H), 7.50-7.60 (m, 1H), 3.85-3.90 (m, 4H), 3.50-3.70 (m, 4H).

5 EXAMPLE 19

7-(3,4-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride

A mixture of 4-[7-(3,4-dimethyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (260 mg, 0.58 mmol), H₂O₂ (30% in water, 0.5 mL), trifluoroacetic acid (1.5 mL) was heated at 50 °C, 2h. The reaction was continued overnight at 35 °C. A
10 water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂, dichloromethane:methanol 9:1) The free base was converted into hydrochloride by treatment with HCl in diethyl ether to obtained 20 mg of the title compound. ¹H NMR
15 (CH₃OH-*d*₄) δ 8.75-8.80 (m, 1H), 8.10-8.25 (m, 3H), 7.70-7.85 (m, 2H), 7.60-7.70 (m, 1H), 7.35-7.40 (m, 1H), 3.90-4.00 (m, 4H), 3.55-3.65 (m, 4H), 2.35 (bs, 6H).

EXAMPLE 20

7-(2,5-Dimethyl-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride

A mixture of 4-[7-(2,5-dimethyl-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (380 mg, 0.846 mmol), H₂O₂ (30% in water, 0.5 mL), trifluoroacetic acid (3 mL) was heated at 50 °C, 2h. The reaction was continued overnight at 35 °C. A
20 water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂,
25 dichloromethane:methanol 9.8:0.2→9.5:0.5) The free base was converted into hydrochloride by treatment with HCl in diethyl ether to obtained 120 mg of the title compound. ¹H NMR (CH₃OH-*d*₄) δ 8.75-8.80 (m, 1H), 8.25-8.30 (m, 1H), 8.05-8.20 (m, 2H), 7.60-7.70 (m, 3H), 7.30-7.35 (m, 1H), 4.00-4.10 (m, 4H), 3.60-3.70 (m, 4H), 2.30-
30 1.35 (bs, 6H).

EXAMPLE 21

7-(*p*-Chloro-benzenesulfonyl)-1-piperazin-1-yl-isoquinoline hydrochloride

A mixture of 4-[7-(*p*-chloro-phenylsulfanyl)-isoquinolin-1-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (297 mg, 0.65 mmol), H₂O₂ (30% in water, 0.5 mL), trifluoroacetic acid (3 mL) was heated at 50 °C, 2h. The reaction was continued overnight at 35 °C. A water solution of NaOH (1N) was added (pH = 14), ethyl acetate was added and the organic phase was separated, dried (MgSO₄), filtered. The filtrate was concentrated and the residue was purified by flash column chromatography (SiO₂, dichloromethane:methanol 9.5:0.5→9.0:1.0) The free base was converted into hydrochloride by treatment with HCl in diethyl ether to obtained 70 mg of the title compound. ¹H NMR (CH₃OH-*d*₄) δ 8.75-8.85 (m, 2H), 8.10-8.25 (m, 3H), 8.00-8.08 (m, 2H), 7.60-7.68 (m, 3H), 3.85-3.95 (m, 4H), 3.55-3.65 (m, 4H).

EXAMPLE 22

7-Benzenesulfonyl-1-[1,4]diazepan-1-yl-isoquinoline hydrochloride

30 mg. ¹H NMR (DMSO-*d*₆) δ 9.3 (s, 1 H), 8.58 (s, 1 H), 8.26-8.30 (d, *J* = 9 Hz, 1 H), 8.1-8.13 (m, 2 H), 8.01-8.06 (d, *J* = 6 Hz, 1 H), 7.6-7.76 (m, 3 H), 7.53-7.58 (d, *J* = 6 Hz, 1 H), 3.70-3.90 (m, 4H) 3.58-3.66 (m, 2 H), 3.29-3.40 (m, 2H); LCMS: 368,369 HPLC: 98 %.

EXAMPLE 23

7-(4-*tert*-Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl-isoquinoline hydrochloride

Isolated 69 mg. ¹H NMR (DMSO-*d*₆) δ 9.2 (s, 1 H), 8.65 (s, 1 H), 8.09-8.15 (d, *J* = 6 Hz, 1 H), 8.03-8.08 (d, *J* = 15 Hz, 1 H), 7.89-7.96 (d, *J* = 9 Hz, 2 H), 7.60-7.67 (d, *J* = 9 Hz, 2 H), 7.33-7.38 (d, *J* = 9 Hz, 1 H), 4.01-4.09 (m, 2 H), 3.83-3.91 (m, 2 H), 3.43-3.52 (m, 2 H), 3.23-3.33 (m, 2 H), 1.25 (s, 9 H); LCMS: 424,425, HPLC: 97 %.

EXAMPLE 24

7-(2-Chloro-6-methyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl-isoquinoline hydrochloride

Isolated 27 mg ¹H NMR (DMSO-*d*₆) δ 8.81 (s, 1 H), 8.28 (m, 1 H), 8.10-8.18 (d, *J* = 6 Hz, 1 H), 7.94-8.08 (m, 2 H), 7.45-7.62 (m, 3 H), 7.36-7.42 (d, *J* = 6 Hz, 1 H), 3.75-3.86 (m, 2

H), 3.41-3.51 (m, 2 H), 3.18-3.32 (m, 2 H), 2.86 (s, 3 H), 2.14-2.19 (m, 2 H); LCMS: 416,418 HPLC: 98 %.

EXAMPLE 25

5 7-(3,5-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline hydrochloride

Isolated 62 mg. ¹H NMR (DMSO-*d*₆) δ 9.35 (s, 1 H), 8.67 (m, 1 H), 8.00-8.18 (m, 3 H), 7.58-7.69 (m, 2 H), 7.45-7.41 (d, *J* = 6 Hz, 1 H), 7.30-7.35 (m, 1 H), 4.06-4.14 (m, 2 H), 3.86-3.97 (m, 2 H), 3.42-3.52 (m, 2 H), 3.23-3.31 (m, 2 H), 2.33 (s, 6 H) 2.23-2.25 (m, 2 H); LCMS: 436,438, HPLC: 95 %.

10

EXAMPLE 26

7-(3,4-Dichloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline, hydrochloride

Isolated 11 mg. ¹H NMR (CD₃OD) δ 8.88 (m, 1 H), 8.23-8.29 (d, *J* = 12 Hz, 1 H), 8.13-8.16 (d, *J* = 3 Hz, 1 H), 8.04-8.10 (d, *J* = 9 Hz, 1 H), 7.88-7.94 (d, *J* = 9 Hz, 1 H), 7.79-7.84 (d, *J* = 6 Hz, 1 H), 7.67-7.73 (d, *J* = 9 Hz, 1 H), 7.42-7.46 (d, *J* = 6 Hz, 1 H), 4.28-4.35 (m, 2 H), 4.09-4.16 (m, 2 H), 3.69-3.75 (m, 2 H), 2.33-2.46 (m, 2 H); LCMS: 368,369; HPLC: 97 %.

15

EXAMPLE 27

20 7-(4-Chloro-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline, hydrochloride

Isolated 41 mg. ¹H NMR (DMSO-*d*₆) δ 9.27 (s, 1 H), 8.68 (m, 1 H), 7.99-8.17 (m, 5 H), 7.66-7.75 (d, *J* = 9 Hz, 2 H), 7.33-7.39 (d, *J* = 6 Hz, 1 H), 4.03-4.11 (m, 2 H), 3.83-3.93 (m, 2 H), 3.43-3.53 (m, 2 H), 3.23-3.32 (m, 2 H), 2.19-2.30 (m, 2 H); LCMS: 402,404; HPLC: 98 %.

25

EXAMPLE 28

7-(3,4-Dimethyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline, hydrochloride

Isolated 10 mg. ¹H NMR (DMSO-*d*₆) δ 9.41 (s, 1 H), 8.67 (s, 1 H), 8.00-8.16 (m, 3 H), 7.76-7.82 (m, 1 H), 7.68-7.77 (d, *J* = 9 Hz, 1 H), 7.32-7.42 (d, *J* = 9 Hz, 2 H), 3.99-4.40 (m, 4 H), 3.49 (m, 2 H), 3.33 (m, 2 H), 2.29 (s, 3 H), 2.25 (s, 3 H); LCMS: 396,397; HPLC: 92 %.

30

EXAMPLE 29

7-(2-*tert*-Butyl-benzenesulfonyl)-1-[1,4]diazepan-1-yl]-isoquinoline, hydrochloride

Isolated 5 mg. ¹H NMR (DMSO-*d*₆) δ 9.27 (s, 1 H), 8.52 (s, 1 H), 8.06-8.16 (m, 2 H),
5 7.97-7.97 (m, 2 H), 7.72-7.78 (m, 1 H), 7.61-7.70 (m, 1 H), 7.40-7.45 (d, *J* = 9 Hz, 2 H),
3.69-3.99 (m, 4 H), 3.43 (s, 2 H), 3.25 (s, 2 H), 2.05-2.26(m, 2 H);1.52 (s, 9 H); LCMS:
424,425; HPLC: 90 %.

EXAMPLE 30

10 **7-Benzenesulfonyl-1-piperazin-yl-isoquinoline, hydrochloride**

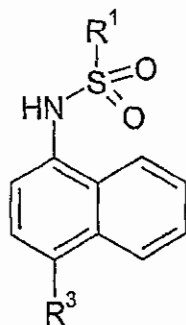
Isolated 10 mg. ¹H NMR (DMSO-*d*₆) δ 9.04 (s, 1 H), 8.65 (s, 1 H), 8.12-8.16 (d, *J* = 6 Hz,
1 H), 7.98-8.05 (m, 5 H), 7.58-7.72 (m, 2 H), 7.32-7.36 (d, *J* = 6 Hz, 1 H), 3.98-4.04 (m, 4
H), 3.80-3.86 (m, 4 H); LCMS: 354,355; HPLC: 98 %.

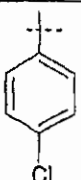
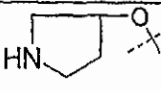
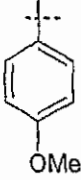
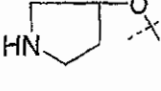
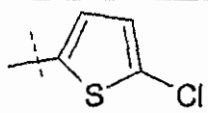
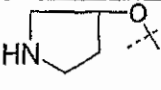
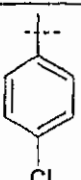
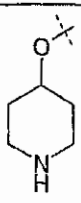
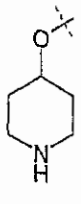
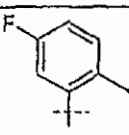
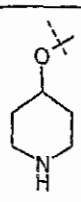
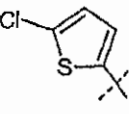
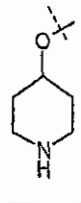
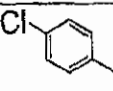
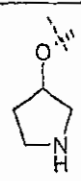
15 EXAMPLE 31

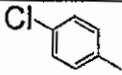
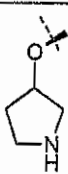
7-(4-*tert*-Butyl-benzenesulfonyl)-1-piperazin-yl-isoquinoline, hydrochloride

Isolated 10 mg. ¹H NMR (DMSO-*d*₆) δ 9.33 (s, 1 H), 8.57 (s, 1 H), 8.24-8.29 (d, *J* = 9 Hz,
1 H), 8.11 (m, 2 H), 7.91-7.97 (d, *J* = 9 Hz, 2 H), 7.60-7.66 (d, *J* = 12 Hz, 2 H), 7.52-7.57
(d, *J* = 6 Hz, 1 H), 3.59-3.68 (m, 4 H), 3.29-3.40 (m, 4 H), 1.24 (s, 9 H); LCMS: 410,411
20 HPLC: 90 %.

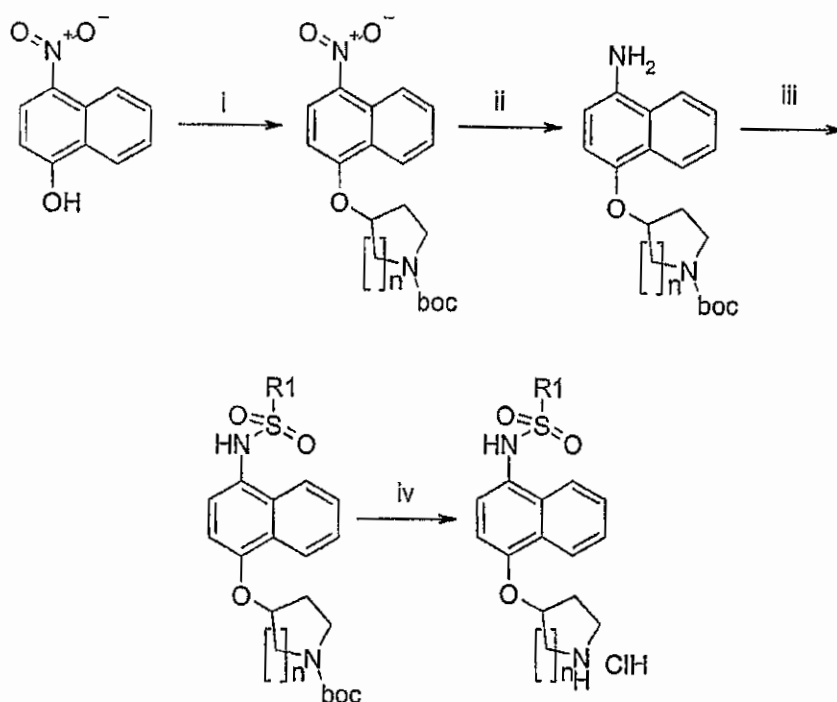
Table 3



EXAMPLE	NAME	R ¹	R ³
32	4-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride		
33	4-Methoxy-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride		
34	5-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride		
35	4-Chloro-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride		
26	4-Methoxy-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride		
37	5-Fluoro-2-methyl-N-[4-(piperidin-4-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride		
38	5-Chloro-N-[4-(piperidin-4-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride		
39	4-Chloro-N-{4-[(3S)-pyrrolidin-3-yloxy]-1-naphthyl}benzenesulfonamide hydrochloride		

40	4-Chloro-N-{4-[(3R)-pyrrolidin-3-yloxy]-1-naphthyl} benzenesulfonamide hydrochloride		
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Scheme 4



Legend to Scheme 4: (i) *tert*-butyl 3-hydroxypyrrolidine-1-carboxylate or *tert*-butyl 4-hydroxypiperidine-1-carboxylate, PPh₃, DEAD, THF; (ii) H₂(g), Pd/C, MeOH; (iii) R₁-SO₂-Cl, pyridine, CH₂Cl₂; (iv) HCl in diethyl ether

General method C

Mitsunobu reaction of 4-nitro-1-naphthol with boc-protected 3-hydroxypyrrolidine and 4-hydroxypiperidine 4-Nitro-1-naphthol (1 equiv.) was dissolved in THF (3 mL/mmol), *tert*-butyl 3-hydroxypyrrolidine-1-carboxylate (2 equiv.) was added followed by PPh₃ (2 equiv.). The solution was kept under N₂-atmosphere and cooled with ice-bath. Diethylazodicarboxylate (DEAD; 2 equiv.) was added dropwise. The ice-bath was removed after 10 min and the reaction mixture was stirred at ambient temperature overnight. The solvent was evaporated and the residue was re-dissolved in EtOAc. The

formed precipitate was collected by filtration. The solution was concentrated in vacuo and purified by flash chromatography (SiO₂, EtOAc:*iso*-hexane 2:8→EtOAc)

General method D

5 Reduction of nitronaphthalene derivatives

To a solution of corresponding nitronaphthalenes (1 equiv.) (prepared by General method A) in MeOH (2 mL/mmol), was added Pd/C (10%) and the reaction mixture was stirred overnight under hydrogen (1 atm). The reaction mixture was filtered and the filtrate was concentrated *in vacuo* to give corresponding aminonaphthalene derivatives.

10

General method E

Reaction of aminonaphthalene derivatives with sulfonyl chlorides

To a solution of the aminonaphthalene derivatives (1 equiv.) in CH₂Cl₂ (8 mL/mmol) was added pyridine (3 equiv.) followed by the corresponding sulfonyl chloride (1.2 equiv.). The mixtures were stirred at ambient temperature overnight, washed with HCl (1M) (2 mL) and dried (MgSO₄). The volatiles were eliminated under vacuo and gave the crude product which were purified by flash chromatography (SiO₂, EtOAc:*iso*-hexane 1:4) to give desired sulfonamide.

15

20 General method F

Deprotection of boc-group

The sulfonamide derivatives (prepared by General Method C) were dissolved in a small amount of MeOH and treated with an excess of HCl in diethyl ether (1M). Stirring at ambient temperature overnight resulted in a precipitate which were collected by filtration giving the title compounds as its hydrochloride salts.

25

General method G

3-Hydroxypyrrolidine (1equiv.) was dissolved in MeOH (1mL/mmol) and cooled on ice-bath. (BOC)₂O (1.1equiv.) was added and the mixture was stirred for 2 h at ambient temperature. Pyridine/water (10/10mL) was added and the mixture was stirred overnight. Evaporation of solvents and co-evaporation with toluene provided the desired boc-protected 3-hydroxypyrrolidine.

30

INTERMEDIATE 28

***tert*-Butyl 3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate (General Method C)**

The crude product was purified by column chromatography. The compound was prepared from 4-nitro-1-naphthol (2.85 g, 15.1 mmol). The material thus obtained was dissolved in small amount of EtOAc and *iso*-hexane was added. The formed solid was collected by filtration and triturated with MeOH to give the pure title compound 4.6g (85%). HPLC 99%, R_T =2.70 (System A1, 10-97% MeCN over 3 min). ^1H NMR (400 MHz, CDCl_3) δ ppm 1.46 (d, J =7.03 Hz, 9 H) 2.26-2.38 (m, 2 H) 3.60-3.81 (m, 4 H) 5.20 (br s, 1 H) 6.76 (d, J =8.53 Hz, 1 H) 7.58 (t, J =7.53 Hz, 1 H) 7.73 (t, J =7.53 Hz, 1 H) 8.34 (dd, J =20.33, 8.78 Hz, 2 H) 8.75 (d, J =9.04 Hz, 1 H). MS (ESI+) for $\text{C}_{19}\text{H}_{22}\text{N}_2\text{O}_5$ m/z 376.2 ($\text{M}+\text{NH}$) $^+$, 359.2 ($\text{M}+\text{H}$) $^+$, 303.2 ($\text{M}-t\text{Bu}$) $^+$. HPLC 99%, R_T =2.78 min (System B1, 10-90% MeCN over 3 min).

INTERMEDIATE 29

***tert*-Butyl 3-[(4-amino-1-naphthyl)oxy]pyrrolidine-1-carboxylate (General Method D)**

The compound was prepared from intermediate 1 (2.6 g, 7.2 mmol), Yield : 2.1g (87 %) of the title compound as purple solid. HPLC 96 %, R_T =1.768 min (System A1, 10-97 % MeCN over 3 min). HPLC 95 %, R_T =1.604 min (System B1, 10-90% MeCN over 3 min). ^1H NMR (400 MHz, $\text{DMSO}-d_6$) δ ppm 1.37 (d, J =22.59 Hz, 9 H) 2.12 (s, 2 H) 3.43-3.46 (m, 4 H) 4.96 (s, 1 H) 5.50 (s, 2 H) 6.63 (d, J =8.03 Hz, 1 H) 6.81 (d, J =8.03 Hz, 1 H) 7.41 (dd, J =6.02, 3.01 Hz, 2 H) 7.94-8.01 (m, 2 H). MS (ESI+) for $\text{C}_{19}\text{H}_{24}\text{N}_2\text{O}_3$ m/z 329.2 ($\text{M}+\text{H}$) $^+$, 273.2 ($\text{M}-t\text{Bu}$) $^+$, 229.2 ($\text{M}-\text{Boc}$) $^+$.

INTERMEDIATE 30

***tert*-Butyl 3-[(4-[(4-chlorophenyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate (General method E)**

The compound was prepared from intermediate 2 (0.2 g, 0.61 mmol). The crude material was triturated with CH_3CN to give 0.14 g (46 %) of the title compound as a pale pink solid. HPLC 97 %, R_T =2.703 min (System A1, 10-97 % MeCN over 3 min). ^1H NMR (400 MHz, CDCl_3) δ ppm 1.46 (d, J =4.02 Hz, 9 H) 2.18-2.30 (m, 2 H) 3.54-3.76 (m, 4 H) 5.05 (br s, 1 H) 6.62-6.65 (m, 1 H) 6.74-6.76 (m, 1 H) 7.17-7.23 (m, 1 H) 7.32 (d, J =9.04 Hz, 2 H)

7.39-7.45 (m, 2 H) 7.62 (d, $J=8.53$ Hz, 2 H) 7.68-7.72 (m, 1 H) 8.16-8.19 (m, 1 H). MS (ESI+) for $C_{25}H_{27}ClN_2O_5S$ m/z 520.2 ($M+NH_4$)⁺, 447.0 ($M-tBu$)⁺. HPLC 98%, $R_T=2.738$ min (System B1, 10-90% MeCN over 3 min).

5 INTERMEDIATE 31

***tert*-Butyl 3-[(4-{[(4-methoxyphenyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method E*)

The compound was prepared from intermediate 2 (0.2 g, 0.61 mmol), Yield: 0.2g (66%) of the title compound as a pink oil. HPLC 98%, $R_T=2.617$ min (System A1, 10-97% MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.45 (d, $J=5.02$ Hz, 9 H) 2.14-2.31 (m, 2 H) 3.54-3.76 (m, 4 H) 3.79 (s, 3 H) 5.04 (br s, 1 H) 6.60-6.65 (m, 2 H) 6.81 (d, $J=8.53$ Hz, 2 H) 7.15-7.24 (m, 1H) 7.38-7.44 (m, 2 H) 7.60-7.64 (m, 2 H) 7.71-7.76 (m, 1 H) 8.14-8.18 (m, 1 H). MS (ESI+) for $C_{26}H_{30}N_2O_6S$ m/z 516.4 ($M+NH_4$)⁺, 443.0 ($M-tBu$)⁺, 399.2 ($M-Boc$)⁺.

15

INTERMEDIATE 32

***tert*-Butyl 3-[(4-{[(5-chloro-2-thienyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method E*)

The compound was prepared from intermediate 2 (0.2 g, 0.61 mmol), Yield: 0.21g (68%) of the title compound as a yellow solid. HPLC 99%, $R_T=2.777$ min (System B1, 10-90% MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, $J=6.02$ Hz, 9 H) 2.16-2.30 (m, 2 H) 3.55-3.74 (m, 4 H) 5.07 (br s, 1 H) 6.67-6.70 (m, 1 H) 6.75 (d, $J=4.02$ Hz, 1 H) 6.77 (br s, 1 H) 7.13 (br s, 1 H) 7.28-7.35 (m, 1 H) 7.46-7.48 (m, 2 H) 7.75-7.79 (m, 1 H) 8.19-8.22 (m, 1 H). MS (ESI+) for $C_{23}H_{25}ClN_2O_5S_2$ m/z 526.2 ($M+NH_4$)⁺, 453.0 ($M-tBu$)⁺, 409.2 ($M-Boc$)⁺. HPLC 99%, $R_T=2.767$ min (System A1, 10-97% MeCN over 3 min).

25

INTERMEDIATE 33

***tert*-Butyl 4-[(4-nitro-1-naphthyl)oxy]piperidine-1-carboxylate** (*General method C*)

The compound was prepared from 4-nitro-1-naphthol (2 g, 10.6 mmol). The material obtained after flash chromatography was not pure according to NMR. Recrystallization from EtOAc/*iso*-hexane gave 2.3g (62%) of the title compound as a yellow solid. HPLC 98%, $R_T=2.842$ min (System A1, 10-97% MeCN over 3 min) ¹H NMR (400 MHz, CDCl₃)

30

δ ppm 1.48 (s, 9 H) 1.99 (m, 4 H) 3.54 (m, 2 H) 3.70 (m, 2 H) 4.87 (m, 1 H) 6.82 (d, $J=9.04$ Hz, 1 H) 7.59 (m, 1 H) 7.74 (m, 1 H) 8.38 (d, $J=8.53$ Hz, 2 H) 8.77 (d, $J=8.53$ Hz, 1 H). MS (ESI+) for $C_{20}H_{24}N_2O_5$ m/z 373.0 (M+H)⁺, 390.2 (M+NH₄)⁺, 317.0 (M-*t*Bu)⁺. HPLC 98%, $R_T=2.973$ min (System B1, 10-90% MeCN over 3 min).

5

INTERMEDIATE 34

***tert*-Butyl 4-[(4-amino-1-naphthyl)oxy]piperidine-1-carboxylate** (*General Method C*)

The compound was prepared from intermediate 6 (2.3 g, 7.0 mmol), Yield: 2g (95%) as pink oil. HPLC 94%, $R_T=2.885$ min (System B1, 10-90% MeCN over 3 min). ¹H NMR

10 (400 MHz, CDCl₃) δ ppm 1.46 (s, 9 H) 1.80-1.98 (m, 4 H) 3.35-3.41 (m, 2 H) 3.46 (s, 3 H) 3.69-3.75 (m, 2 H) 3.88 (br s, 1 H) 4.50-4.54 (m, 1 H) 7.45-7.50 (m, 2 H) 7.79-7.81 (m, 1 H) 8.22-8.24 (m, 1 H). MS (ESI+) for $C_{20}H_{26}N_2O_3$ m/z 343.2 (M+H)⁺. HPLC 94%, $R_T=2.735$ min (System A1, 10-97% MeCN over 3 min).

15 INTERMEDIATE 35

***tert*-Butyl 4-[(4-[(4-chlorophenyl)sulfonyl]amino)-1-naphthyl]oxy]piperidine-1-carboxylate** (*General method E*)

The compound was prepared from intermediate 7 (0.25 g, 0.73 mmol), Yield: 0.29g (77%). HPLC 98%, $R_T=2.906$ min (System A1, 10-97% MeCN over 3 min). ¹H NMR (400 MHz,

20 CDCl₃) δ ppm 1.47 (s, 9 H) 1.88 (m, 2 H) 1.98 (m, 2 H) 3.47 (m, 2 H) 3.68 (m, 2 H) 4.69 (m, 1 H) 6.61 (s, 1 H) 6.70 (d, $J=8.03$ Hz, 1 H) 7.17 (d, $J=8.03$ Hz, 1 H) 7.32 (m, 2 H) 7.43 (m, 2 H) 7.62 (m, 2 H) 7.70 (m, 1 H). MS (ESI+) for $C_{26}H_{29}ClN_2O_5S$ m/z 534.0 (M+NH₄)⁺, 461.2 (M-*t*Bu)⁺. HPLC 98%, $R_T=2.843$ min (System B1, 10-90% MeCN over 3 min).

25 INTERMEDIATE 36

***tert*-Butyl 4-[(4-[(4-methoxyphenyl)sulfonyl]amino)-1-naphthyl]oxy]piperidine-1-carboxylate** (*General method E*)

The compound was prepared from intermediate 7 (0.25 g, 0.73 mmol). Yield: 0.21g (56%) of the title compound as pink solid. HPLC 100%, $R_T=2.755$ min (System A1, 10-97%

30 MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.47 (s, 9 H) 1.86-2.01 (m, 4 H) 3.43-3.49 (m, 2 H) 3.65-3.71 (m, 2 H) 3.79 (s, 3 H) 4.65-4.70 (m, 1 H) 6.58 (s, 1 H) 6.69

(d, $J=8.53$ Hz, 1 H) 6.83-6.79 (m, 2 H) 7.17 (d, $J=8.03$ Hz, 1 H) 7.39-7.44 (m, 2 H) 7.61-7.64 (m, 2 H) 7.75-7.77 (m, 1 H) 8.21-8.24 (m, 1 H). MS (ESI+) for $C_{27}H_{32}N_2O_6S$ m/z 530.2 ($M+NH_4$)⁺, 457.2 ($M-tBu$)⁺, 413.4 ($M-Boc$)⁺. HPLC 99%, $R_T=2.668$ min (System B1, 10-90% MeCN over 3 min).

5

INTERMEDIATE 37

***tert*-Butyl 4-[(4-[(5-fluoro-2-methylphenyl)sulfonyl]amino}-1-naphthyl)oxy]piperidine-1-carboxylate (General method E)**

The compound was prepared from *tert*-butyl 4-[(4-amino-1-naphthyl)oxy]piperidine-1-carboxylate (0.25 g, 0.73 mmol). Yield: 0.24 g (64 %) of the title compound as a pink solid. HPLC 99 %, $R_T=2.809$ min (System B1, 10-90% MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (s, 9 H) 1.83-1.98 (m, 4 H) 2.54 (s, 3 H) 3.42-3.48 (m, 2 H) 3.63-3.69 (m, 2 H) 4.64-4.68 (m, 1 H) 6.64-6.68 (m, 2 H) 7.03 (d, $J=8.53$ Hz, 1 H) 7.10 (m, 1 H) 7.22 (dd, $J=8.53, 5.02$ Hz, 1 H) 7.44-7.48 (m, 2 H) 7.55 (dd, $J=8.53, 2.51$ Hz, 1 H) 7.83-7.86 (m, 1 H) 8.24 (m, 1 H). MS (ESI+) for $C_{27}H_{31}FN_2O_5S$ m/z 532.2 ($M+NH_4$)⁺, 459.2 ($M-tBu$)⁺, 415.2 ($M-Boc$)⁺. HPLC 100 %, $R_T=2.877$ min (System A1, 10-97% MeCN over 3 min).

INTERMEDIATE 38

***tert*-Butyl 4-[(4-[(5-chloro-2-thienyl)sulfonyl]amino}-1-naphthyl)oxy]piperidine-1-carboxylate (General method E)**

The compound was prepared from *tert*-butyl 4-[(4-amino-1-naphthyl)oxy]piperidine-1-carboxylate (0.25g, 0.73mmol). Yield: 0.25 g (65 %) of the title compound as a pink solid. HPLC 98 %, $R_T=2.827$ min (System B1, 10-90% MeCN over 3 min). ¹H NMR (400 MHz, CDCl₃) δ ppm 1.47 (s, 9 H) 1.86-2.03 (m, 4 H) 3.45-3.51 (m, 2 H) 3.66-3.72 (m, 2 H) 4.69-4.74 (m, 1 H) 6.66 (s, 1 H) 6.74-6.76 (m, 2 H) 7.14 (d, $J=4.02$ Hz, 1 H) 7.30 (d, $J=8.03$ Hz, 1 H) 7.45-7.50 (m, 2 H) 7.76-7.79 (m, 1 H) 8.25-8.28 (m, 1 H) MS (ESI+) for $C_{24}H_{27}ClN_2O_5S_2$ m/z 540.4 ($M+NH_4$)⁺, 467.2 ($M-tBu$)⁺. HPLC 99 %, $R_T=2.910$ min (System A1, 10-97 % MeCN over 3 min).

30

INTERMEDIATE 39

***tert*-Butyl (3R)-3-hydroxypyrrolidine-1-carboxylate** (General method G)

The compound was prepared from (3R)-3-hydroxypyrrolidine (5 g, 57.4 mmol). Yield: 9.6 g (90 %) of the title compound. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.43 (s, 9 H) 1.90-1.98 (m, 2 H) 3.27-3.47 (m, 4H) 4.40 (br s, 1H).

INTERMEDIATE 40

***tert*-Butyl (3S)-3-hydroxypyrrolidine-1-carboxylate** (General method G)

The compound was prepared from (3S)-3-hydroxypyrrolidine (5 g, 57.4 mmol). Yield: 8 g (86 %) of the title compound. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.40 (s, 9 H) 1.86-1.91 (m, 2 H) 3.24-3.42 (m, 4H) 4.36 (br s, 1H).

INTERMEDIATE 41

***tert*-Butyl (3S)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (General method C)

The compound was prepared from *tert*-butyl (3R)-3-hydroxypyrrolidine-1-carboxylate (3.56 g, 19 mmol) and 4-nitro-1-naphthol (3 g, 15.9 mmol). Yield: 5 g (88 %) of the title compound as yellow oil. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.45 (d, J=7.03 Hz, 9 H) 2.22-2.38 (m, 2 H) 3.54-3.83 (m, 4 H) 5.18 (br s, 1 H) 6.74 (d, J=8.53 Hz, 1 H) 7.56 (t, J=7.78 Hz, 1 H) 7.71 (t, J=7.78 Hz, 1 H) 8.29 (d, J=8.53 Hz, 1 H) 8.33 (d, J=8.53 Hz, 1 H) 8.72 (d, J=8.53 Hz, 1 H). MS (ESI+) for C₁₉H₂₂N₂O₅ m/z 376.2 (M+ NH₄)⁺, 303.2 (M-tBu)⁺. HPLC 100 %, R_T=2.768 min (System A1, 10-97% MeCN over 3 min).

INTERMEDIATE 42

***tert*-Butyl (3R)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (General method C)

The compound was prepared from *tert*-butyl (3S)-3-hydroxypyrrolidine-1-carboxylate (3.56 g, 19 mmol) and 4-nitro-1-naphthol (3 g, 15.9 mmol). Yield: 2.8 g (49 %) of the title compound as yellow oil. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, J=7.03 Hz, 9 H) 2.26-2.38 (m, 2 H) 3.55-3.81 (m, 4 H) 5.20 (br s, 1 H) 6.77 (d, J=8.53 Hz, 1 H) 7.59 (t,

J=7.53 Hz, 1 H) 7.72-7.76 (m, 1 H) 8.32 (d, J=8.03 Hz, 1 H) 8.37 (d, J=8.53 Hz, 1 H) 8.76 (d, J=8.53 Hz, 1 H). HPLC 95 %, R_T =2.775 min (System A1, 10-97 % MeCN over 3 min).

INTERMEDIATE 43

5 ***tert*-Butyl (3S)-3-[(4-amino-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method D*)

The compound was prepared from *tert*-butyl (3S)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate (5 g, 14 mmol). Yield: 3.5 g (76 %) of the title compound as dark pink solid.

¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, J=14.56 Hz, 9 H) 2.08-2.13 (m, 1 H) 2.27-2.30 (m, J=13.05 Hz, 1 H) 3.54-3.77 (m, 4 H) 3.88 (br s, 2 H) 4.96 (br s, 1 H) 6.65-6.70 (m, 2 H) 7.45-7.51 (m, 2 H) 7.79-7.81 (m, 1 H) 8.15-8.19 (m, 1H). MS (ESI+) for C₁₉H₂₄N₂O₃ m/z 329.2 (M+H)⁺, 273.2 (M-tBu)⁺, 229.2 (M-Boc)⁺. HPLC 95 %, R_T =1.854 min (System A1, 10-97 % MeCN over 3 min).

15 INTERMEDIATE 44

***tert*-Butyl (3R)-3-[(4-amino-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method D*)

The compound was prepared from *tert*-butyl (3R)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate (2.8 g, 7.8 mmol). Yield: 1.8 g (72 %) of the title compound as dark pink

20 solid. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, J=14.56 Hz, 9 H) 2.07-2.14 (m, 1 H) 2.27-2.30 (m, 1 H) 3.54-3.77 (m, 4 H) 3.93 (br s, 2 H) 4.96 (br s, 1 H) 6.65-6.70 (m, 2 H) 7.45-7.51 (m, 2 H) 7.79-7.81 (m, 1 H) 8.16-8.18 (m, 1H). MS (ESI+) for C₁₉H₂₄N₂O₃ m/z 329.2 (M+H)⁺, 273.2 (M-tBu)⁺, 229.2 (M-Boc)⁺. HPLC 94 %, R_T =1.751 min (System A1, 10-97% MeCN over 3 min).

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INTERMEDIATE 45

***tert*-Butyl (3S)-3-[(4-[[[(4-chlorophenyl)sulfonyl]amino]-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method E*)

The compound was prepared from *tert*-butyl (3S)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate (0.3 g, 0.9 mmol) and 4-chloro-phenylsulfonylchloride (0.23 g, 1.1 mmol).

30 Yield: 0.23 g (50 %) of the title compound. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, J=4.52 Hz, 9 H) 2.15-2.34 (m, 2 H) 3.54-3.74 (m, 4 H) 5.05 (br s, 1 H) 6.62-6.71 (m, 2 H)

7.17-7.23 (m, 1 H) 7.33 (d, J=8.53 Hz, 1 H) 7.39-7.43 (m, 2 H) 7.62-7.64 (m, 2 H) 7.65-7.70 (m, J=6.02 Hz, 1 H) 8.18 (d, J=8.53 Hz, 1 H) MS (ESI+) for C₂₅H₂₇ClN₂O₅S m/z 520.2 (M+NH₄)⁺, 447.0 (M-tBu)⁺. HPLC 100 %, R_T=2.772 min (System A1, 10-97 % MeCN over 3 min).

5

INTERMEDIATE 46

***tert*-Butyl (3R)-3-[(4-[(4-chlorophenyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate** (*General method E*)

The compound was prepared from *tert*-butyl (3R)-3-[(4-nitro-1-naphthyl)oxy]pyrrolidine-1-carboxylate (0.3 g, 0.9 mmol) and 4-chloro-phenylsulfonylchloride (0.23 g, 1.1 mmol). Yield: 0.4 g (87 %) of the title compound. ¹H NMR (400 MHz, CDCl₃) δ ppm 1.46 (d, J=4.52 Hz, 9 H) 2.15-2.34 (m, 2 H) 3.54-3.74 (m, 4 H) 5.05 (br s, 1 H) 6.60-6.66 (m, 2 H) 7.17-7.23 (m, 1 H) 7.33 (d, J=8.53 Hz, 1 H) 7.39-7.43 (m, 2 H) 7.62-7.64 (m, 2 H) 7.65-7.70 (m, J=6.02 Hz, 1 H) 8.18 (d, J=8.53 Hz, 1 H) MS (ESI+) for C₂₅H₂₇ClN₂O₅S m/z 520.2 (M+NH₄)⁺, 447.0 (M-tBu)⁺. HPLC 100 %, R_T=2.769 min (System A1, 10-97 % MeCN over 3 min).

EXAMPLE 32

4-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride (*General method F*)

The compound was prepared from intermediate 3 (0.13 g, 0.26 mmol). The solid was further purified by trituration with diethyl ether giving 0.11 g (95%) of the title compound as white solid. HPLC 98%, R_T=1.810 min (System A1, 10-97% MeCN over 3 min). ¹H NMR (400 MHz, DMSO-d₆) δ ppm 2.21-2.26 (m, 2 H) 3.32-3.37 (m, 2 H) 3.48-3.50 (m, 2 H) 5.28 (br s, 1 H) 6.91-6.98 (m, 2 H) 7.44-7.50 (m, 2 H) 7.56-7.64 (m, 4 H) 7.88-7.90 (m, 1 H) 8.20-8.23 (m, 1 H). MS (ESI+) for C₂₀H₁₉ClN₂O₃S m/z 401.2 (M+H)⁺. HPLC 98%, R_T=1.651 min (System B1, 10-90% MeCN over 3 min).

EXAMPLE 33

4-Methoxy-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride
(General method F)

The compound was prepared from intermediate 4 (0.18 g, 0.36 mmol), Yield: 0.12 g
(76%) of the title compound as a white solid. HPLC 100%, $R_T=1.490$ min (System B1, 10-
90% MeCN over 3 min). ^1H NMR (400 MHz, DMSO- d_6) δ ppm 2.20-2.25 (m, 2 H) 3.31-
3.53 (m, 4 H) 3.78 (s, 3 H) 5.27 (br s, 1 H) 6.90-6.97 (m, 2 H) 7.00 (d, $J=8.53$ Hz, 2 H)
7.43-7.48 (m, 2 H) 7.57 (d, $J=8.53$ Hz, 2 H) 7.93-7.96 (m, 1 H) 8.19-8.22 (m, 1 H) 9.63 (br
s, 2 H). MS (ESI+) for $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_4\text{S}$ m/z 409.2 ($\text{M}+\text{H}$) $^+$. HPLC 100%, $R_T=1.639$ min
(System A1, 10-97% MeCN over 3 min).

EXAMPLE 34

5-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]thiophene-2-sulfonamide
hydrochloride (General method F)

The compound was prepared from intermediate 5 (0.20 g, 0.39 mmol), Yield: 0.14 g (80%)
of the title compound as a pale white solid. HPLC 99%, $R_T=1.651$ min (System B1, 10-
90% MeCN over 3 min). ^1H NMR (400 MHz, DMSO- d_6) δ ppm 2.23-2.26 (m, 2 H) 3.28-
3.39 (m, 2 H) 3.40-3.56 (m, 2 H) 5.32 (br s, 1 H) 6.99 (d, $J=8.53$ Hz, 1 H) 7.13 (d, $J=8.03$
Hz, 1 H) 7.15 (d, $J=4.02$ Hz, 1 H) 7.26 (d, $J=4.02$ Hz, 1 H) 7.48-7.52 (m, 2 H) 7.92 (dd,
 $J=6.53, 3.01$ Hz, 1 H) 8.25 (dd, $J=6.53, 3.01$ Hz, 1 H) 9.60 (s, 1 H). MS (ESI+) for
 $\text{C}_{18}\text{H}_{17}\text{ClN}_2\text{O}_3\text{S}_2$ m/z 409.2 ($\text{M}+\text{H}$) $^+$. HPLC 99%, $R_T=1.818$ min (System A1, 10-97%
MeCN over 3 min).

EXAMPLE 35

4-Chloro-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride
(General method F)

The compound was prepared from intermediate 8 (0.26 g, 0.50 mmol), Yield: 0.12 g
(53%) of the title compound as a white solid. HPLC 100%, $R_T=1.872$ min (System A1, 10-
97% MeCN over 3 min). ^1H NMR (400 MHz, DMSO- d_6) δ ppm 1.95-1.99 (m, 2 H) 2.14-
2.19 (m, 2 H) 3.11 (br s, 2 H) 3.26 (br s, 2 H) 4.84 (br s, 1 H) 6.92-6.99 (m, 2 H) 7.44-7.51
(m, 2 H) 7.57-7.65 (m, 4 H) 7.91 (d, $J=7.53$ Hz, 1 H) 8.17 (d, $J=7.03$ Hz, 1 H) 8.94 (br s, 1

H) 9.05 (br s, 1 H) 10.11 (s, 1 H). MS (ESI+) for $C_{21}H_{21}ClN_2O_3S$ m/z 415.2 (M+H)⁺.
HPLC 99%, R_T =1.657 min (System B1, 10-90% MeCN over 3 min).

EXAMPLE 36

5 **4-Methoxy-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride**
(General method F)

The compound was prepared from intermediate 9 (0.19 g, 0.37 mmol), Yield: 0.15 g (90%)
of the title compound as a white solid. HPLC 97%, R_T =1.508 min (System B1, 10-90%
MeCN over 3 min). ¹H NMR (400 MHz, DMSO- d_6) δ ppm 1.96 (m, 2 H) 2.16 (m, 2 H)
10 3.10 (m, 2 H) 3.26 (m, J =6.02 Hz, 2 H) 3.78 (s, 3 H) 4.82 (m, 1 H) 6.95 (q, J =8.20 Hz, 1
H) 7.01 (d, J =9.04 Hz, 2 H) 7.47 (m, 2 H) 7.57 (m, 2 H) 7.96 (m, 1 H) 8.16 (m, 1 H) 8.96
(s, 1 H) 9.07 (s, 1 H) 9.81 (s, 1 H). MS (ESI+) for $C_{22}H_{24}N_2O_4S$ m/z 413.4 (M+H)⁺. HPLC
97%, R_T =1.713 min (System A1, 10-97% MeCN over 3 min).

15 **EXAMPLE 37**

5-Fluoro-2-methyl-N-[4-(piperidin-4-yloxy)-1-naphthyl]benzenesulfonamide
hydrochloride (General method F)

The compound was prepared from intermediate 10 (0.24 g, 0.47 mmol).
Yield: 0.21 g (99%) of the title compound as an off-white solid. HPLC 100%, R_T =1.823
20 min (System A1, 10-97% MeCN over 3 min). ¹H NMR (400 MHz, CH₃OH- d_4) δ ppm
2.13 (m, 4 H) 2.42 (s, 3 H) 3.18 (m, 2 H) 3.37 (m, 2 H) 4.83 (m, 1 H) 6.81 (d, J =8.53 Hz, 1
H) 6.97 (d, J =8.03 Hz, 1 H) 7.10 (m, 1 H) 7.24 (m, J =8.53, 5.52 Hz, 1 H) 7.35 (m, 3 H)
7.83 (m, 1 H). MS (ESI+) for $C_{22}H_{23}FN_2O_3S$ m/z 415.2 (M+H)⁺. HPLC 96%, R_T =1.628
min (System B1, 10-90% MeCN over 3 min).

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EXAMPLE 38

5-Chloro-N-[4-(piperidin-4-yloxy)-1-naphthyl]thiophene-2-sulfonamide
hydrochloride (General method F)

The compound was prepared from tert-butyl 4-[(4-[(5-fluoro-2-methylphenyl)-
30 sulfonyl]amino}-1-naphthyl)oxy]piperidine-1-carboxylate (0.24 g, 0.46 mmol). Yield: 0.16
g (76%) of the title compound as a white solid. ¹H NMR (400 MHz, DMSO- d_6) δ ppm
1.96-2.03 (m, 2 H) 2.16-2.22 (m, 2 H) 3.09-3.14 (m, 2 H) 3.25-3.31 (m, 2 H) 4.86-4.89 (m,

1 H) 7.04-7.11 (m, 2 H) 7.16 (d, $J=4.02$ Hz, 1 H) 7.26 (d, $J=4.02$ Hz, 1 H) 7.48-7.53 (m, 2 H) 7.92-7.94 (m, 1 H) 8.19-8.21 (m, 1 H) 9.06 (br s, 1 H) 10.36 (br s, 1 H). MS (ESI+) for $C_{19}H_{19}ClN_2O_3S_2$ m/z 423.0 (M+H)⁺. HPLC 99 %, $R_T=1.861$ min (System A1, 10-97 % MeCN over 3 min).

5

EXAMPLE 39

4-Chloro-N-{4-[(3S)-pyrrolidin-3-yloxy]-1-naphthyl}benzenesulfonamide hydrochloride (*General method F*)

The compound was prepared from *tert*-butyl (3S)-3-[(4-{[(4-chlorophenyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate (0.22 g, 0.44 mmol). Yield: 0.15 g (78 %) of the title compound as a yellow solid. ¹H NMR (400 MHz, CH₃OH-*d*₄) δ ppm 2.37-2.49 (m, 2 H) 3.52-3.56 (m, 2 H) 3.61-3.71 (m, 2 H) 5.37 (br s, 1 H) 6.87 (d, $J=8.03$ Hz, 1 H) 7.14 (d, $J=8.03$ Hz, 1 H) 7.38-7.47 (m, 4 H) 7.61 (d, $J=8.53$ Hz, 2 H) 7.83 (d, $J=8.03$ Hz, 1 H) 8.22 (d, $J=8.03$ Hz, 1 H). MS (ESI+) for $C_{20}H_{19}ClN_2O_3S$ m/z 403.2 (M+H)⁺. HPLC 100 %, $R_T=1.826$ min (System A1, 10-97 % MeCN over 3 min).

15

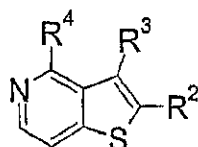
EXAMPLE 40

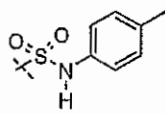
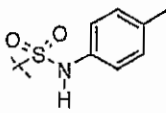
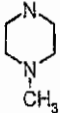
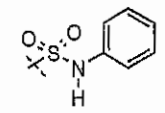
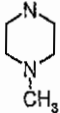
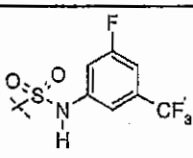
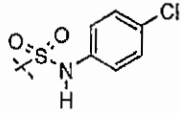
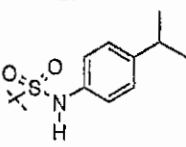
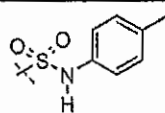
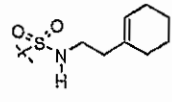
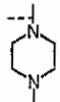
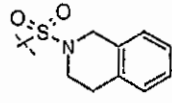
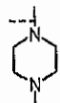
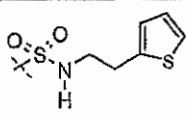
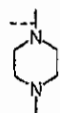
4-Chloro-N-{4-[(3R)-pyrrolidin-3-yloxy]-1-naphthyl}benzenesulfonamide hydrochloride (*General method F*)

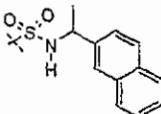
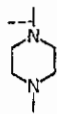
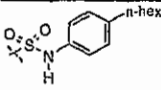
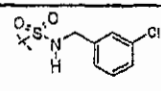
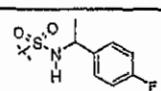
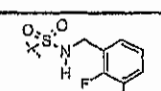
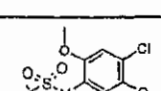
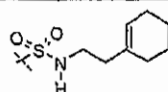
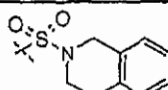
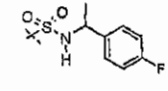
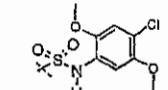
The compound was prepared from *tert*-butyl (3R)-3-[(4-{[(4-chlorophenyl)sulfonyl]amino}-1-naphthyl)oxy]pyrrolidine-1-carboxylate (0.37 g, 0.74 mmol). Yield: 0.27 g (82 %) of the title compound as a off-white solid. ¹H NMR (400 MHz, CH₃OH-*d*₄) δ ppm 2.37-2.49 (m, 2 H) 3.52-3.56 (m, 2 H) 3.61-3.71 (m, 2 H) 5.37 (br s, 1 H) 6.88 (d, $J=8.53$ Hz, 1 H) 7.15 (d, $J=8.03$ Hz, 1 H) 7.39-7.47 (m, 4 H) 7.60-7.62 (m, 2 H) 7.83 (d, $J=7.53$ Hz, 1 H) 8.22 (d, $J=8.03$ Hz, 1 H). MS (ESI+) for $C_{20}H_{19}ClN_2O_3S$ m/z 403.2 (M+H)⁺. HPLC 100 %, $R_T=1.815$ min (System A1, 10-97 % MeCN over 3 min).

25

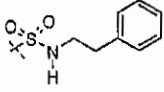
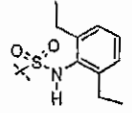
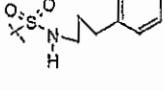
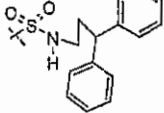
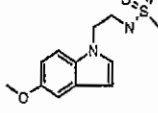
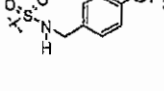
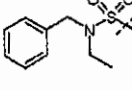
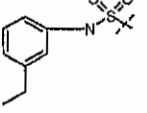
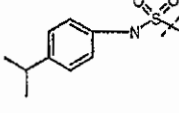
Table 4



EXAMPLE		R ²	R ³	R ⁴
41	N-(4-Methylphenyl)-4-(4-methylpiperazin-1-yl)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
42	2-Bromo-4-(4-methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-3-sulfonic acid p-tolylamide hydrochloride	Br		
43	4-(4-Methylpiperazin-1-yl)-N-phenylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
44	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3-fluoro-5-trifluoromethyl-phenyl)-amide hydrochloride		H	
45	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-chloro-phenyl)-amide hydrochloride		H	
46	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-isopropyl-phenyl)-amide hydrochloride		H	
47	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid p-tolylamide hydrochloride		H	
48	4-(4-Methylpiperazin-1-yl)-N-(2-cyclohex-1-en-1-ylethyl) thieno [3,2-c] pyridine-2-sulfonamide hydrochloride		H	
49	2-(4-(4-Methylpiperazin-1-yl) thieno [3,2-c] pyridin-2-ylsulfonyl)-1,2,3,4-tetrahydroisoquinoline hydrochloride		H	
50	4-(4-Methylpiperazin-1-yl)-N-(2-thien-2-ylethyl) thieno [3,2-c] pyridine-2-sulfonamide hydrochloride		H	

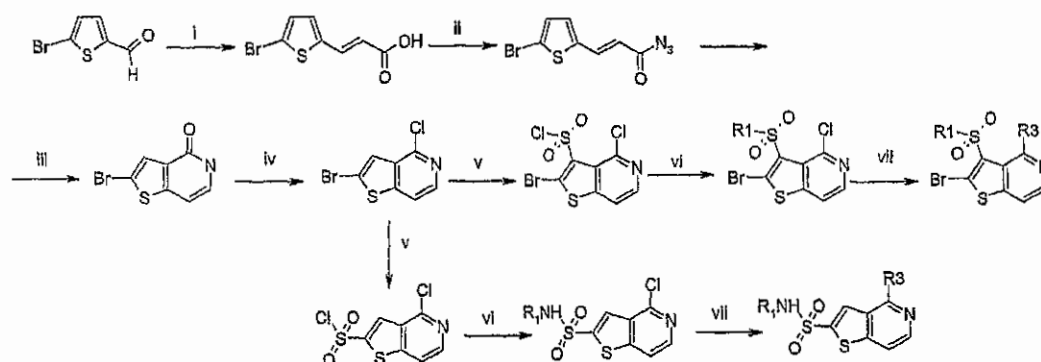
51	4-(4-Methylpiperazin-1-yl)- <i>N</i> - [1-(1-naphthyl) ethyl] thieno [3,2- <i>c</i>] pyridine-2-sulfonamide hydrochloride		H	
52	4-(4-Methylpiperazin-1-yl)- <i>N</i> - (4-hexylphenyl) thieno [3,2- <i>c</i>] pyridine-2-sulfonamide hydrochloride		H	
53	<i>N</i> - (3-Chlorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2- <i>c</i>] pyridine-2-sulfonamide		H	
54	4-(4-Methylpiperazin-1-yl)- <i>N</i> - [1-(4-fluorophenyl) ethyl] thieno [3,2- <i>c</i>] pyridine-2-sulfonamide hydrochloride		H	
55	<i>N</i> - (2,3-Difluorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2- <i>c</i>] pyridine-2-sulfonamide hydrochloride		H	
56	4-(4-Methylpiperazin-1-yl)- <i>N</i> - (4-chloro-2,5-dimethoxyphenyl) thieno [3,2- <i>c</i>] pyridine-2-sulfonamide hydrochloride		H	
57	2-Bromo-4- (4-methylpiperazin-1-yl)- <i>N</i> - (2-cyclohex-1-en-1-ylethyl) thieno [3,2- <i>c</i>] pyridine-3-sulfonamide hydrochloride	Br		
58	2-[2-Bromo-4-(4-methylpiperazin-1-yl)-benzo[b]thiophene-3-sulfonyl]-1,2,3,4-tetrahydro-isoquinoline	Br		
59	2-Bromo-4- (4-methylpiperazin-1-yl)- <i>N</i> - [1-(4-fluorophenyl) ethyl] thieno [3,2- <i>c</i>] pyridine-3-sulfonamide hydrochloride	Br		
60	2-Bromo-4- (4-methylpiperazin-1-yl)- <i>N</i> - (4-chloro)-(2, 5-dimethoxyphenyl) thieno [3,2- <i>c</i>] pyridine-3-sulfonamide hydrochloride	Br		

61	N-(3,4-Dichlorophenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
62	N-(2,4-Difluorophenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
63	4-Piperazin-1-yl-N-[-3-(trifluoromethyl)phenyl]thieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
64	N-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
65	N-(3,4-Dimethoxyphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
66	N-(4-Bromo-2-methylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
67	2-(4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonyl)-1,2,3,4-tetrahydro-isoquinoline hydrochloride		H	
68	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2-thiophen-2-yl-ethyl)-amide hydrochloride		H	
69	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-chloro-2,5-dimethoxyphenyl)-amide hydrochloride		H	

70	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid phenethyl-amide hydrochloride		H	
71	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2,6-diethyl-phenyl)-amide hydrochloride		H	
72	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3-phenyl-propyl)-amide hydrochloride		H	
73	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3,3-diphenyl-propyl)-amide hydrochloride		H	
74	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid [2-(5-methoxy-1H-indol-3-yl)-ethyl]-amide hydrochloride		H	
75	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid 4-trifluoromethyl-benzylamide hydrochloride		H	
76	4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid benzyl-ethyl-amide hydrochloride		H	
77	N-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride	H		
78	N-(4-Isopropylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride	H		

79	N-(4-Methylphenyl)-4-(pyrrolidin-3-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
80	N-(4-Methylphenyl)-4-(piperidin-4-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
81	N-(2,3-Difluorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	
82	N-(3-Chlorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		H	

Scheme 5



Legend to Scheme 5: i) Malonic acid, pyridine, piperidine, heat; ii) ethylchloroformate, acetone, NaN_3 -10 °C; iii) diphenyl ether, 220 °C; iv) POCl_3 , heat; v) gas SO_2 , $n\text{-BuLi}$, N-chlorosuccinimide, CH_2Cl_2 ; vi) $\text{R}^1\text{-NH}_2$, pyridine; vii) HR^3 , K_2CO_3 , DMSO, heat.

INTERMEDIATE 47

(2E)-3-(5-Bromothiophen-2-yl) acrylic acid

Malonic acid (44.40 g, 426.7 mmol) was added to a mixture of 5-bromothiophene-2-carbaldehyde (50 g, 261.7 mmol), piperidine (2.84 mL) and pyridine (150 mL). The mixture was refluxed for 1 h at 80°C and then at 100 °C over night. The volatiles were evaporated and the residue was dissolved in water and acidified with hydrochloric acid (pH 2). The crude product was crystallized in ethanol. Yield: 55.24 g (90.5 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 6.14 (d, *J*=15.83 Hz, 1 H) 7.11-7.16 (m, 2 H) 7.68 (d, *J*=16.36 Hz, 1 H); MS 233.1 (*M* – H)⁺; Purity (HPLC) 94 %.

INTERMEDIATE 48

10 (2*E*)-3-(5-Bromothiophen-2-yl) acryloyl azide

Thionyl chloride (1.04 mL) was added to a solution of (2*E*)-3-(5-bromothiophen-2-yl) acrylic acid (1.04 g, 4.46 mmol) in chloroform (20 mL) and the mixture was refluxed for 2h at 75°C and then used in the next step. The above solution was added drop wise to a stirred suspension of sodium azide (0.58 g, 8.93 mmol), dioxane (3 mL) and water (3 mL) in an ice bath. After 10 min a precipitate appeared which was filtered off and washed with water. The residue was dissolved in dichloromethane, dried with MgSO₄, filtered and the solvent was removed to afford: 0.96 g (83.4 %). ¹H NMR (270 MHz CH₃OH-d₄) δ ppm 6.20 (d, *J*=15.57 Hz, 1 H) 7.15-7.25 (m, 2 H) 7.80 (d, *J*=15.57 Hz, 1 H); MS 258.1 (*M* – H)⁺; Purity (HPLC) 65 %.

20

INTERMEDIATE 49

2-Bromothiopheno [3,2-*c*] pyridin-4 (5*H*)-one

A solution of (2*E*)-3-(5-bromothiophen-2-yl) acryloyl azide (18.00 g, 69.7 mmol) solved in dichloromethane (100 mL) was added dropwise to diphenyl ether (90 mL) at 150 °C. The temperature was increased to 220°C for 1h. The mixture was cooled to room temperature followed by the addition of ether. The solid precipitated and was separated by filtration. Yield: 13.58 g (84.6 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 6.82 (d, *J*=7.13 Hz, 1 H) 7.27 (d, *J*=6.86 Hz, 1 H) 7.54 (s, 1 H) 11.55 (s, 1 H); MS 230.1 (*M* – H)⁺; Purity (HPLC) 92 %.

30

INTERMEDIATE 50

2-Bromo-4-chloro-thieno [3,2-*c*] pyridine

Phosphorus oxychloride (4.08 g, 26.6 mmol) was added dropwise to 2-bromothieno [3,2-*c*] pyridin-4 (5*H*)-one (2.04 g, 8.87 mmol) at 0 °C. The mixture was heated at 135 °C for 2.5h, then carefully poured over ice water. The precipitated was collected by filtration and dried to yield 1.78 g (80.7 %) of title product. ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm 7.67 (d, 1 H) 7.88 (dddd, *J*=6.33 Hz, 2 H) 8.19 (d, *J*=5.54 Hz, 1 H); MS 248.0 (M – H)⁺; Purity (HPLC) 100 %.

10 INTERMEDIATE 51 and INTERMEDIATE 52

4-Chlorothieno [3,2-*c*] pyridine-2-sulfonyl chloride and 2-bromo-4-chlorothieno [3,2-*c*] pyridine-3-sulfonyl chloride

n-Butyl lithium (1.5 mL, 2.4 mmol) was added to 2-bromo-4-chlorothieno [3,2-*c*] pyridine (0.5 g, 2 mmol) dissolved in dry THF (15 mL) at -78°C under nitrogen. The mixture was stirred for 40 min. The above solution was added to a dry ether saturated with SO₂ (gas) at -78°C. The mixture was warmed to room temperature, followed by the addition of ether. The precipitate was separated by filtration. The two title products were obtained and taken to the next step without further purification as follows: N-chlorosuccinimide (2.07 g, 10.3 mmol) was added to [(4-chlorothieno [3,2-*c*] pyridin-2-yl) sulfonyl] lithium and [(2-bromo-4-chlorothieno [3,2-*c*] pyridin-3-yl) sulfonyl] lithium in dichloromethane (150 mL) at 0 °C. The mixture was heated at 60 °C for 2h, extracted with water (3 x 50 mL). The organic phase was separated, dried with MgSO₄, filtrated and the volatiles were eliminated by vacuum distillation. The crude products were used in the next step without further purification.

25

INTERMEDIATE 53 and INTERMEDIATE 54

4-Chloro-2-thieno [3,2-*c*] pyridine-2- sulfonic acid p-tolylamide and 2-bromo-4-chloro-thieno[3,2-*c*]pyridine-3-sulfonic acid p-tolylamide

p-Toludine (30 mg, 2.87 mmol) was added to a solution of 4-chlorothieno [3,2-*c*] pyridine-2-sulfonyl chloride and 2-bromo-4-chlorothieno [3,2-*c*] pyridine-3-sulfonyl chloride (0.07 g, 0.26 mmol) in dichloromethane and pyridine (0.19 mL). The reaction was stirred at

room temperature for 2h. The solvent was removed and the crude mixture was taken to the next step without further purification.

EXAMPLE 41 and EXAMPLE 42

5 **4-(4-Methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-2-sulfonic acid p-tolylamide hydrochloride and 2-bromo-4-(4-methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-3-sulfonic acid p-tolylamide hydrochloride**

A mixture of 4-chloro-2-thieno [3,2-c] pyridine-2- sulfonic acid p-tolylamide and 2-bromo-4-chloro-thieno[3,2-c]pyridine-3-sulfonic acid p-tolylamide (70 mg, 0.21 mmol) in
10 DMSO (2 mL), 1-methyl piperazine (0.344 mL, 3.1 mmol) and K₂CO₃ (28.5 mg, 0.21 mmol) was heated to 100°C over night. The reaction mixture was dissolved in water and extracted with ethyl acetate (3 x 10 mL). The organic layers were collected and the solvent was removed. The products were purified by HPLC to afford 1.9 mg of 4-(4-Methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-2-sulfonic acid p-tolylamide. The free base was
15 converted into the hydrochloride salt by treatment with HCl in ether: ¹H NMR (270 MHz, Methanol-d₄) δ ppm 2.26 (s, 3H) 2.98 (s, 3 H) 3.40-3.55 (m, 8 H) 7.02-7.10 (m, 6 H) 7.55 (d, J=5.81 Hz, 1 H) 7.69 (s, 1 H) 8.13 (d, J=5.81 Hz, 1 H); LC-MS 403 (M + H)⁺; Purity (LC-MS) 92 % and 3.8 mg 2-bromo-4-(4-methyl-piperazin-1-yl)-thieno[3,2-c]pyridine-3-sulfonic acid p-tolylamide. The free base was converted into the hydrochloride salt by
20 treatment with HCl in ether: ¹H NMR (270 MHz, Methanol-d₄) δ ppm 2.21 (s, 1H) 3.00 (d, 3H) 3.50-3.77 (m, 8 H) 7.00-7.10 (m, 6 H) 7.63 (d, J=5.81 Hz, 1 H) 8.19 (d, J=5.81 Hz, 1 H); LC-MS 481 (M + H)⁺; Purity (LC-MS) 98 %.

Reaction of sulfonyl chloride with amines (Method H)

25 To a solution of the amine (1.3 equiv.) and pyridine (8 equiv.) in DCM was added the sulfonyl chloride (1 equiv.) and the reaction mixture was stirred over night. After addition of Trisamine™ (ca 2 equiv.), the mixture was gently shaken for additional 3 h. The suspension was then filtered through a short silica plug by the aid of DCM and ethyl acetate. The solvent was evaporated, and the residue was dissolved in DCM and washed
30 with 1 M aqueous HCl (2 times). The combined organic phases were dried (MgSO₄), filtered, and the solvent was removed to give the sulfonamide product. In cases of low-

purity material, the products were purified by silica gel flash chromatography. The products are used in the next step (Procedure B).

Coupling with aromatic amines (Method I)

- 5 To the reaction mixtures from the Method H, dissolved in DMSO (2mL), amines (15 equiv.) and K_2CO_3 (1 equiv.) are added. The reactions are stirred at 100°C for 24 and then concentrated. The products are purified by LC-MS. The solvents are removed under vacuum by SpeedVac and purified by preparative LC/MS. The products that were not pure enough (Purity $\leq 90\%$) were purified by preparative chromatography using acetonitrile-
10 water gradients containing 0.1% trifluoroacetic acid. After HPLC analysis fractions that were $\geq 90\%$ pure were collected and concentrated. Deprotection of the amine in the piperazine was performed by first dissolving the substance in methanol and adding portions of 1M HCl/ether. The reactions are analyzed by TLC. The solvents were concentrated under vacuum by a SpeedVac.

15

Deprotection of BOC-group (Method L)

- The sulfone or sulfonamide derivative (prepared by Methods H and I) were dissolved in a small amount of MeOH/DCM 1:1 and treated with an excess of 1 M HCl in diethyl ether. Stirring at ambient temperature overnight resulted in a precipitate which were collected by
20 filtration to give the products as their corresponding hydrochloride salts.

EXAMPLE 43

4-(4-Methylpiperazin-1-yl)-N-phenylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

- 25 The synthesis was performed essentially as described in Method H-L. Yield: 8.1 mg (33.8 %). 1H NMR (270 MHz, CH_3OH-d_4) δ ppm 8.13 (d, $J=5.81$ Hz, 1 H) 7.67 (s, 1 H) 7.54 (d, $J=5.81$ Hz, 1 H) 7.55-7.53 (m, 5H) 2.97 (s, 3 H) (4H obscured by solvent signal); LC-MS 389 (M - H) $^+$; Purity (HPLC) 100 %.

EXAMPLE 44

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3-fluoro-5-trifluoromethyl-phenyl)-amide hydrochloride

4-[2-(3-Fluoro-5-trifluoromethyl-phenylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid tert-butyl ester (0.235 mmol, 1 equiv.) was used as the thienopyridine in Method H-L. Yield: 25.7 mg HPLC: t_R = 3.395 (System: 5% to 50 % ACN in 3 min, C8), Purity: 100 %, LC/MS: t_R = 1.375 (System: 30% to 60% ACN in 1.5 min, Hypersil BDS),
5 Purity: 99 %. MS: 461 (M+1) ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm 3.47 (m, 4 H) 3.53 (s, 1 H) 3.87 (m, 4 H) 7.21 (m, 1 H) 7.29 (m, 1 H) 7.33 (s, 1 H) 7.66 (d, J =6.33 Hz, 1 H).

EXAMPLE 45

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-chloro-phenyl)-amide hydrochloride

4-Chloro-thieno[3,2-c]pyridine-2-sulfonic acid (3-fluoro-5-trifluoromethyl-phenyl)-amide (0.208 mmol, 1 equiv.) was used as the thienopyridine in Method H-L. Yield: 7.2 mg HPLC: t_R = 3.039 (System: 5 % to 50 % ACN in 3 min, C8), Purity: 100%, LC/MS: t_R = 0.905 (System: 30 % to 60 % ACN in 1.5 min, Hypersil BDS), Purity: 97%. MS: 409
15 (M+1). ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm 3.50 (m, 4 H) 3.91 (m, 4 H) 7.25 (m, 4 H) 7.71 (dd, J =6.33, 0.53 Hz, 1 H) 7.96 (d, J =0.79 Hz, 1 H) 8.04 (d, J =6.33 Hz, 1 H).

EXAMPLE 46

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-isopropyl-phenyl)-amide hydrochloride

4-Chloro-thieno[3,2-c]pyridine-2-sulfonic acid (4-isopropyl-phenyl)-amide (0.201 mmol, 1 equiv.) was used as the thienopyridine in Method H-L. Yield: 6.9 mg HPLC: t_R = 3.255 (System: 5 % to 50 % ACN in 3 min, C8), Purity: 95%, LC/MS: t_R = 1.255 (System: 30% to 60 % ACN in 1.5 min, Hypersil BDS), Purity: 98 %. MS: 417 (M+1). ^1H NMR (270
25 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm 1.18 (d, J =6.86 Hz, 6 H) 2.83 (m, 2 H) 3.52 (m, 4 H) 4.00 (m, 4 H) 7.14 (m, 3 H) 7.75 (d, J =6.60 Hz, 1 H) 8.02 (m, 1 H).

EXAMPLE 47

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid *p*-tolylamide hydrochloride

30 To a solution of 4-chloro-thieno[3,2-c]pyridine-2-sulfonyl chloride (0.640 g, 2.39 mmol) in DCM (20 mL) was added pyridine (1.9 mL, 23.9 mmol) followed by *p*-tolylamine (0.307 g, 2.86 mmol). The reaction mixture was stirred at room temperature for 16 hours. The

mixture was concentrated and re-dissolved in DMSO (10 mL), piperazine-1-carboxylic acid *tert*-butyl ester (1.34 g, 7.17 mmol) and K₂CO₃ (0.989 g, 7.17 mmol) were added. The mixture was stirred at 100 °C for 16 hours and then concentrated. The crude reaction mixture was dissolved in EtOAc (100 mL) and washed with brine (2 x 50 mL). The organic phase was dried (Na₂SO₄) and concentrated. The crude intermediate was purified by column chromatography on silica using EtOAc/*n*-pentane (1:1) as eluent. The intermediate was dissolved in EtOAc/MeOH and diethyl ether saturated with HCl (g) was added. The mixture was stirred at room temperature for 16 hours. The precipitate was collected by filtration and washed with diethyl ether/*n*-pentane to give 0.475 g of the crude product. Purification by preparative reversed phase HPLC gave 0.133 g of the pure product: ¹H NMR (DMSO-*d*₆, 25 °C, 270.17 MHz) δ 10.61 (br s, 1H), 9.23 (br s, 2H), 8.13 (d, *J* = 5.80 Hz, 1H), 7.91 (s, 1H); 7.67 (d, *J* = 5.80 Hz, 1H), 7.09-7.07 (m, 4H), 3.68-3.59 (m, 4H), 3.33-3.22 (m, 4H), 2.20 (s, 3H) ; *m/z* (posESI) 399 (M+H).

15 EXAMPLE 48

4-(4-Methylpiperazin-1-yl)-*N*-(2-cyclohex-1-en-1-ylethyl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. Yield: 25.6 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.49-10.48 (m, 1H) 8.23-7.95 (m, 3H) 7.72-7.71 (m, 1H) 5.34-5.33 (m, 1H) 4.14-4.11 (m, 2H) 3.53-3.51 (m, 2H) 3.29-3.25 (m, 2H) 2.98-2.97 (m, 2H) 2.85 (s, 3H) 2.04-1.81 (m, 4H) 1.57-1.15 (m, 8H); LC-MS 420.17 (M - H)⁺; Purity (LC-MS) 97 %.

EXAMPLE 49

25 2-(4-(4-Methylpiperazin-1-yl) thieno [3,2-*c*] pyridin-2-ylsulfonyl)-1,2,3,4-tetrahydroisoquinoline hydrochloride

The synthesis was preformed essentially as described in Method H-L. Yield: 15.5 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.49-10.48 (m, 1H) 8.17-8.15 (m, 1H) 7.86-7.85 (m, 1H) 7.70-7.65 (m, 2H) 7.28-7.12 (m, 3H) 3.97-3.94 (m, 2H) 3.87-3.85 (m, 2H) 3.25-3.18 (m, 2H) 2.84 (s, 3H) 1.67-1.65 (m, 2H) 3.51-3.34 (6H obscured by solvent signal); LC-MS 428.13 (M - H)⁺; Purity (LC-MS) 99 %.

EXAMPLE 50

4-(4-Methylpiperazin-1-yl)-N- (2-thien-2-ylethyl) thieno [3,2-c] pyridine-2-sulfonamide hydrochloride

5 The synthesis was preformed essentially as described in Method H-L. Yield: 29.5 mg ¹H NMR (270 MHz, DMSO-d₆) δ ppm 10.28-10.27 (m, 1H) 8.34-8.33 (m, 1H) 8.19-8.17 (m, 1H) 8.01-8.00 (m, 1H) 7.71-7.69 (m, 1H) 7.31-7.30 (m, 1H) 6.91-6.87 (m, 1H) 4.13-4.10 (m, 2H) 3.53-3.51 (m, 2H) 3.29-3.25 (m, 2H) 3.17-3.16 (m, 2H) 2.99-2.95 (m 4H) 2.86 (s, 3H); LC-MS 422.09 (M - H)⁺; Purity (LC-MS) 99%.

10

EXAMPLE 51

4-(4-Methylpiperazin-1-yl)-N- [1-(1-naphthyl) ethyl] thieno [3,2-c] pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. 20.1 mg ¹H NMR
15 (270 MHz, DMSO-d₆) δ ppm 10.28-10.27 (m, 1H) 8.85-8.84 (m, 1H) 8.02-8.01 (m, 1H) 7.67-7.60 (m, 4H) 7.53-7.50 (m, 2H) 7.39-7.36 (m, 2H) 4.72-4.70 (m, 1H) 3.87-3.84 (m, 1H) 3.72-3.70 (m, 1H) 3.23-3.13 (m, 4H) 2.84 (s, 3H) 1.42-1.40 (m 3H); LC-MS 466.15 (M - H)⁺; Purity (LC-MS) 99 %.

20 EXAMPLE 52

4-(4-Methylpiperazin-1-yl)-N- (4-hexylphenyl) thieno [3,2-c] pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. 8.0 mg ¹H NMR
25 (270 MHz, DMSO-d₆) δ ppm 10.39-10.38 (m, 1H) 8.16-8.15 (m, 1H) 7.90-7.89 (m, 1H) 7.66-7.65 (m, 1H) 7.09-7.08 (m, 4H) 4.00-3.98 (m, 2H) 3.51-3.48 (m, 2H) 3.26-3.22 (m, 2H) 2.85 (s, 3H) 2.49-2.45 (m, 2H) 1.48-1.46 (m, 2H) 1.24-1.22 (m, 8H) 0.82-0.81 (m, 3H); LC-MS 472.20 (M - H)⁺; Purity (LC-MS) 98 %.

EXAMPLE 53

***N*- (3-Chlorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride**

The synthesis was preformed essentially as described in Method H-L. 30.7 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.25-10.24 (m, 1H) 8.78-8.77 (m, 1H) 8.18-8.17 (m, 1H) 7.91-7.90 (m, 1H) 7.68-7.67 (m, 1H) 7.26-7.19 (m, 3H) 4.21-4.20 (m, 2H) 4.08-4.05 (m, 2H) 3.54-3.51 (m, 2H) 3.28-3.23 (m, 2H) 2.87 (s, 3H) 2.84-2.60 (2H obscured by solvent signal); LC-MS 436.08 (M - H)⁺; Purity (LC-MS) 94 %.

10 EXAMPLE 54

4-(4-Methylpiperazin-1-yl)-*N*- [1-(4-fluorophenyl) ethyl] thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. 32.9 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.16-10.15 (m, 1H) 8.75-8.73 (m, 1H) 7.63-7.62 (m, 2H) 7.25-7.24 (m, 2H) 6.91-6.88 (m, 2H) 4.58-4.55 (m, 1H) 4.02-3.95 (m, 2H) 3.55-3.53 (m, 2H) 3.25-3.21 (m, 2H) 2.68 (s, 3H) 1.31-1.30 (m, 3H) 2.70-2.64 (2H obscured by solvent signal); LC-MS 434.12 (M - H)⁺; Purity (LC-MS) 92 %.

EXAMPLE 55

20 ***N*- (2,3-Difluorobenzyl)-4-(4-methylpiperazin-1-yl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride**

The synthesis was preformed essentially as described in Method H-L. 26.7 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.36-10.35 (m, 1H) 8.82-8.81 (m, 1H) 7.96-7.95 (m, 1H) 7.69-7.68 (m, 1H) 7.27-7.10 (m, 2H) 4.26-4.25 (m, 2H) 4.11-4.08 (m, 2H) 3.54-3.52 (m, 2H) 3.28-3.24 (m, 2H) 2.68 (s, 3H) 2.86-2.60 (2H obscured by solvent signal); LC-MS 438.10 (M - H)⁺; Purity (LC-MS) 93 %.

EXAMPLE 56

4-(4-Methylpiperazin-1-yl)-N- (4-chloro-2, 5-dimethoxyphenyl) thieno [3,2-*c*] pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. 14.6 mg ¹H NMR

- 5 (270 MHz, DMSO-*d*₆) δ ppm 10.27-10.26 (m, 1H) 10.14-10.13 (m, 1H) 8.18-8.17 (m, 1H) 7.83-7.82 (m, 1H) 7.69-7.68 (m, 1H) 7.09-7.07 (m, 2H) 4.00 (s 2H) 3.76-3.75 (m, 2H) 3.51-3.48 (m, 2H) 3.24-3.22 (m, 2H) 2.85 (s, 3H); LC-MS 482.08 (M - H)⁺; Purity (LC-MS) 95 %.

10 EXAMPLE 57

2-Bromo-4- (4-methylpiperazin-1-yl)-N- (2-cyclohex-1-en-1-ylethyl) thieno [3,2-*c*] pyridine-3-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. 4.6 mg ¹H NMR

- 15 (270 MHz, DMSO-*d*₆) δ ppm 10.30-10.29 (m, 1H) 8.31-8.27 (m, 2H) 7.89-7.88 (m, 1H) 5.27-5.26 (m, 1H) 3.68-3.52 (m, 4H) 3.05-3.04 (m, 2H) 2.88-2.87 (m, 3H) 2.04-2.03 (m, 2H) 2.77-1.81 (m, 2H) 1.54-1.15 (m, 10H); LC-MS 498.08 (M - H)⁺; Purity (LC-MS) 93 %.

EXAMPLE 58

- 20 **2-[2-Bromo-4-(4-methyl-piperazin-1-yl)-benzo[*b*]thiophene-3-sulfonyl]-1,2,3,4-tetrahydro-isoquinoline hydrochloride**

The synthesis was preformed essentially as described in Method H-L. Yield: 3.7 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.30-10.29 (m, 1H) 9.24-9.22 (m, 1H) 8.09-8.08 (m, 1H) 7.67-7.35 (m, 7H) 4.69-4.66 (m, 1H) 2.86-2.85 (m, 3H) 1.50-1.48 (m, 3H) 3.23-2.51

- 25 (8H obscured by solvent signal); LC-MS 544.06 (M - H)⁺; Purity (LC-MS) 92 %.

EXAMPLE 59

2-Bromo-4- (4-methylpiperazin-1-yl)-N- [1-(4-fluorophenyl) eth-2-yl] thieno [3,2-*c*] pyridine-3-sulfonamide hydrochloride

- 30 The synthesis was preformed essentially as described in Method H-L. Yield: 4.3 mg ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 10.35-10.34 (m, 1H) 9.16-9.14 (m, 1H) 8.23-8.22 (m,

1H) 7.80-7.79 (m, 1H) 7.26-7.25 (m, 1H) 4.55-4.52 (m, 1H) 3.54-3.52 (m, 2H) 2.88-2.87 (m, 3H) 1.38-1.36 (m, 3H) 3.17-2.83 (6H obscured by solvent signal); LC-MS 512.04 (M - H)⁺; Purity (LC-MS) 93 %.

5 **EXAMPLE 60**

2-Bromo-4- (4-methylpiperazin-1-yl)-N- (4-chloro)-(2, 5-dimethoxyphenyl) thieno [3,2-*c*] pyridine-3-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. Yield: 0.7 mg, LC-MS 561.91(M - H)⁺; Purity (LC-MS) 95%.

10

EXAMPLE 61

N-(3,4-dichlorophenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride

3,4-Dichloroaniline (0.49 mmol), was dissolved in acetonitrile (1 mL) and pyridine (0.440 mL, 4.03 mmol) was added to a solution of 4-chlorothieno [3,2-*c*] pyridine-2-sulfonyl chloride (0.445 mmol) dissolved in acetonitrile (1 mL). The reaction was shaken for 1h, controlled with HPLC and the solvent was removed. The crude product was used in the next step without further purification. To the reaction mixture from the previous step, dissolved in DMSO (1mL), piperazine (15 equiv.) and K₂CO₃ (1 equiv.) was added. The reaction was stirred at 100 °C for 24 and than concentrated. The product was purified by LC-MS and gave 5.8 mg (2.6 %) of the title product. ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm 8.07-8.05 (m, 2 H) 7.73 (d, *J*=6.60 Hz, 1 H) 7.46-7.41 (m, 2 H) 7.16 (dd, *J*=8.71, 2.38 Hz, 1 H) 3.94-3.90 (m, 4 H) 3.92 (m, 4 H) 3.53-3.50 (m, 4 H); LC-MS 443 (M - H)⁺; Purity (HPLC) 95%.

25

EXAMPLE 62

N-(2,4-Difluorophenyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described in Method H-L. Yield: 4.3 mg (2.1 %). ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm 8.22 (s, 1 H) 8.07-8.01 (m, 2H) 7.79-7.72 (m, 1H) 7.55-7.47 (m, 1H) 7.04-6.94 (m, 2H) 4.00-3.96 (m, 4H) 3.53-3.43 (m, 4H) 2.66 (s, 1H); LC-MS 411 (M - H)⁺; Purity (HPLC) 98 %.

30

EXAMPLE 63

4-Piperazin-1-yl-N-[3-(trifluoromethyl)phenyl]thieno[3,2-c]pyridine-2-sulfonamide hydrochloride

- 5 The synthesis was performed essentially as described in Method H-L. Yield: 2.6 mg (1.2 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.05 (d, *J*=6.60 Hz, 2 H) 7.81-7.60 (m, 3H) 7.50-7.47 (m, 2H) 3.94-3.90 (m, 4H) 3.56-3.49 (m, 4H); LC-MS 443 (M - H)⁺; Purity (HPLC) 99 %.

10 EXAMPLE 64

N-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

- The synthesis was performed essentially as described in Method H-L. Yield: 1.4 mg (0.7 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.35 (s, 1H) 7.58-6.92 (m, 7H) 3.54-3.44 (m, 2H) 3.01-2.95 (m, 4H) 2.66 (s, 1H) 2.18-2.01 (m, 3H); LC-MS 403 (M - H)⁺; Purity (HPLC) 100 %.

EXAMPLE 65

N-(3,4-Dimethoxyphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

- 20 The synthesis was performed essentially as described in Method H-L. Yield: 7.7 mg (3.6 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.04 (d, *J*=6.60 Hz, 1 H) 7.77-7.75 (m, 2H) 6.85-6.83 (m, 2H) 6.68-6.83 (m, 1H) 3.87-3.85 (m, 4H) 3.77-3.75 (m, 6H) 3.49-3.45 (m, 4H) 2.65 (s, 1H); LC-MS 435 (M - H)⁺; Purity (HPLC) 98 %.

25 EXAMPLE 66

N-(4-Bromo-2-methylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

- The synthesis was performed essentially as described in Method H-L. Yield: 12.2 mg (5.3 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.07 (d, *J*=6.33 Hz, 1 H) 7.86-7.79 (m, 2H) 7.40 (d, *J*=1.58 Hz, 1 H) 7.30-7.29 (m, 1H) 7.08 (d, *J*=8.71 Hz, 1 H) 3.96-3.92 (m, 4H) 3.53-3.51 (4H) 2.66 (s, 1H) 2.11 (s, 3H); LC-MS 467 (M - H)⁺; Purity (HPLC) 90 %.

EXAMPLE 67

2-(4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonyl)-1,2,3,4-tetrahydro-isoquinoline hydrochloride

- 5 The synthesis was preformed essentially as described in Method H-L from 4-[2-(3,4-dihydro-1H-isoquinoline-2-sulfonyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.235 mmol, 1 equiv.). Yield: 4.0 mg. LC/MS: t_R = 0.801 (System: 30 % to 60 % ACN in 1.5 min, Hypersil BDS), Purity: 92%. MS: 415 (M+1) ^1H NMR (270 MHz, DMSO- d_6) δ ppm 2.87 (t, J =5.81 Hz, 2 H) 3.30 (s, 4 H) 4.43 (s, 2 H) 7.15 (m, 4 H) 7.70 (d, J =5.54 Hz, 1 H) 8.12 (s, 1 H) 8.18 (d, J =5.54 Hz, 1 H) 6 aliphatic protons were obscured by the water-peak in the spectra and so could not be analyzed.

EXAMPLE 68

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2-thiophen-2-yl-ethyl)-amide hydrochloride

- 15 The synthesis was preformed essentially as described in Method H-L from 4-[2-(2-thiophen-2-yl-ethylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butylester (0.235 mmol, 1 equiv.). Yield: 8.7 mg. LC/MS: t_R = 0.430 (System: 30 % to 60 % ACN in 1.5 min, Hypersil BDS), Purity: 93 %. MS: 409 (M+1) ^1H NMR (270 MHz, DMSO- d_6) δ ppm 2.25 (s, 1 H) 2.75 (s, 1 H) 2.96 (t, J =6.99 Hz, 1 H) 3.16 (q, J =6.51 Hz, 1 H) 3.31 (s, 4 H) 3.70 (s, 4 H) 6.90 (m, 1 H) 7.32 (t, J =5.54 Hz, 1 H) 7.70 (d, J =5.81 Hz, 1 H) 8.04 (d, J =1.85 Hz, 1 H) 8.18 (d, J =5.54 Hz, 1 H) 8.36 (m, 1 H) 9.05 (s, 1 H).

EXAMPLE 69

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (4-chloro-2,5-dimethoxy-phenyl)-amide hydrochloride

- 25 The synthesis was preformed essentially as described in Method H-L from 4-[2-(4-chloro-2,5-dimethoxy-phenylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.) was used as the thienopyridine in Method C. Yield: 14.7 mg. LC/MS: t_R = 0.610 (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 92 %. MS: 469 (M+1) ^1H NMR (270 MHz, DMSO- d_6) δ ppm 3.17 (s, 1 H) 3.27 (s, 4 H) 3.38 (s,

3 H) 3.58 (d, $J=4.22$ Hz, 4 H) 3.77 (s, 3 H) 7.08 (s, 1 H) 7.69 (d, $J=5.81$ Hz, 1 H) 7.81 (s, 1 H) 8.16 (d, $J=5.81$ Hz, 1 H) 9.07 (s, 1 H) 10.17 (s, 1 H).

EXAMPLE 70

5 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid phenethyl-amide hydrochloride

The synthesis was preformed essentially as described in Method H-L from 4-(2-phenethylsulfamoyl-thieno[3,2-c]pyridin-4-yl)-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 3.8 mg. LC/MS: $t_R=0.410$ (System: 30% to 60% ACN in 1.5 min, YMC), Purity: 91 %. MS: 403 (M+1) ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm
10 1.44 (d, $J=7.13$ Hz, 2 H) 3.51 (d, $J=4.75$ Hz, 4 H) 3.54 (s, 2 H) 3.94 (m, 4 H) 7.05 (m, 4 H) 7.16 (m, 1 H) 7.62 (s, 1 H) 7.72 (d, $J=6.60$ Hz, 1 H) 8.00 (d, $J=6.60$ Hz, 1 H).

EXAMPLE 71

15 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (2,6-diethyl-phenyl)-amide hydrochloride

The synthesis was preformed essentially as described in Method H-L from 4-[2-(2,6-diethyl-phenylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 9.0 mg. LC/MS: $t_R=0.830$ (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 92 %. MS: 431 (M+1) ^1H NMR (270 MHz, $\text{DMSO}-D_6$) δ ppm
20 0.96 (t, $J=7.52$ Hz, 6 H) 2.25 (m, 1 H) 2.43 (s, 2 H) 2.75 (t, $J=1.72$ Hz, 1 H) 3.26 (s, 4 H) 3.62 (s, 4 H) 7.09 (s, 1 H) 7.12 (s, 1 H) 7.23 (m, 1 H) 7.73 (d, $J=5.81$ Hz, 1 H) 7.77 (s, 1 H) 8.19 (d, $J=5.81$ Hz, 1 H) 9.04 (s, 1 H) 9.95 (s, 1 H).

EXAMPLE 72

25 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3-phenyl-propyl)-amide hydrochloride

The synthesis was preformed essentially as described in Method H-L from 4-[2-(3-phenyl-propylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 13.0 mg. LC/MS: $t_R=0.726$ (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 91 %. MS: 417 (M+1) ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm
30 1.82 (m, 2 H) 2.63 (m, 2 H) 3.04 (t, $J=6.86$ Hz, 2 H) 3.55 (s, 4 H) 4.09 (s, 4 H) 7.16 (m, 4 H) 7.82 (d, $J=6.60$ Hz, 1 H) 8.05 (d, $J=6.33$ Hz, 1 H) 8.14 (s, 1 H).

EXAMPLE 73

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid (3,3-diphenyl-propyl)-amide hydrochloric acid

- 5 The synthesis was preformed essentially as described in Method H-L from 4-[2-(3,3-diphenyl-propylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 14.4 mg. LC/MS: t_R = 1.109 (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 93 %. MS: 493 (M+1) 1H NMR (270 MHz, DMSO- d_6) δ ppm 2.20 (m, 2 H) 2.80 (m, 2 H) 3.29 (s, 4 H) 3.67 (d, J =5.01 Hz, 4 H) 4.01 (m, 1 H)
10 7.14 (m, 8 H) 7.71 (d, J =5.81 Hz, 1 H) 7.95 (s, 1 H) 8.18 (d, J =5.81 Hz, 1 H) 8.27 (m, 2 H) 9.13 (s, 2 H).

EXAMPLE 74

- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid [2-(5-methoxy-1H-indol-3-yl)-ethyl]-amide hydrochloride**

- The synthesis was preformed essentially as described in Method H-L from 4-{2-[2-(5-methoxy-1H-indol-3-yl)-ethylsulfamoyl]-thieno[3,2-c]pyridin-4-yl}-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 6.1 mg. LC/MS: t_R = 0.364 (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 91 %. MS: 472 (M+1) 1H NMR (270 MHz, CH₃OH- d_4) δ ppm 2.85 (t, J =6.20 Hz, 2 H) 3.48 (t, J =6.20 Hz, 2 H) 3.55 (m, 4 H) 3.80 (s, 3 H) 4.02 (m, 4 H) 6.44 (dd, J =8.71, 2.37 Hz, 1 H) 6.80 (m, 2 H) 6.97 (s, 1 H)
20 7.64 (s, 1 H) 7.67 (s, 1 H) 7.97 (d, J =6.60 Hz, 1 H).

EXAMPLE 75

- 4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid 4-trifluoromethyl-benzylamide hydrochloride**

- The synthesis was preformed essentially as described in Method H-L from 4-[2-(4-trifluoromethyl-benzylsulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.) was used as the thienopyridine in Method C. Yield:
25 1.9 mg. LC/MS: t_R = 0.771 (System: 30% to 60% ACN in 1.5 min, YMC), Purity: 91%. MS: 457 (M+1) 1H NMR (270 MHz, CH₃OH- d_4) δ ppm 3.54 (m, 4 H) 3.98 (m, 4 H) 4.36 (s, 2 H) 7.49 (m, 4 H) 7.74 (d, J =6.86 Hz, 1 H) 8.02 (s, 1 H) 8.07 (d, J =6.60 Hz, 1 H).

EXAMPLE 76

4-Piperazin-1-yl-thieno[3,2-c]pyridine-2-sulfonic acid benzyl-ethyl-amide hydrochloride

- 5 The synthesis was performed essentially as described in Method H-L from 4-[2-(benzyl-ethyl-sulfamoyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid *tert*-butyl ester (0.112 mmol, 1 equiv.). Yield: 6.4 mg. LC/MS: t_R = 0.930 (System: 30 % to 60 % ACN in 1.5 min, YMC), Purity: 95 %. MS: 417 (M+1) ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm 1.03 (t, J = 7.13 Hz, 3 H) 3.37 (m, 2 H) 3.57 (s, 2 H) 3.75 (m, 2 H) 4.11 (s, 2 H) 4.50 (s, 2 H) 5.80 (s, 1 H) 7.32 (m, 5 H) 7.84 (d, J = 6.60 Hz, 1 H) 8.07 (d, J = 6.60 Hz, 1 H) 8.14 (s, 1 H).

INTERMEDIATE 55

- tert*-Butyl-4-(3-[[3-ethylphenyl]amino]sulfonyl)thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate**

- 15 Prepared from *tert*-butyl 4-[3-(chlorosulfonyl)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate (90.0 mg, 0.215 mmol) and 3-ethylaniline (33.9 mg, 0.28 mmol) to give the title compound as an off-white solid (82.7 mg, 76 %). ^1H NMR (400 MHz, CDCl_3) δ 1.03 (t, J = 7.5 Hz, 3 H), 1.48 (s, 9 H), 2.47 (q, J = 7.7 Hz, 2 H), 3.00–3.53 (m, 6 H), 4.02–4.44 (m, 2 H), 6.66 (d, J = 8.0 Hz, 1 H), 6.75 (s, 1 H), 6.66 (d, J = 8.0 Hz, 1 H), 7.02 (t, J = 7.8 Hz, 1 H), 7.67 (d, J = 5.5 Hz, 1 H), 8.24 (s, 1 H), 8.39 (d, J = 5.5 Hz, 1 H), 9.80 (s, 1 H). MS (ESI+) m/z 503.2 (M+H) $^+$. HPLC 97 %, R_T : 3.93 min (5–99 % MeCN over 3 min).

EXAMPLE 77

- 25 **N-(3-Ethylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride**

- Prepared from *tert*-butyl 4-(3-[[3-ethylphenyl]amino]sulfonyl)thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate (81.1 mg, 0.161 mmol) which afforded 19 mg (98 %) of the product as a white solid (38.0 mg, 54 %). ^1H NMR (400 MHz, $\text{CH}_3\text{OH}-d_4$) δ 1.09 (t, J = 7.5 Hz, 3 H), 2.51 (q, J = 7.5 Hz, 2 H), 3.59 (br.s, 8 H), 6.89–6.92 (m, 3 H), 7.12–7.14 (m, 1 H), 8.06 (d, J = 6.0 Hz, 1 H), 8.36 (d, J = 6.0 Hz, 1 H), 8.49 (s, 1 H). MS (ESI+) m/z 403.2 (M+H) $^+$. HPLC 95%, R_T : 3.02 min (5–99% MeCN over 3 min).

INTERMEDIATE 56

***tert*-Butyl 4-(3-bromothieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

A mixture of 3-bromo-4-chlorothieno[3,2-*c*]pyridine (729 mg, 2.93 mmol), *tert*-butyl piperazine-1-carboxylate (1.64 g, 8.80 mmol) and K₂CO₃ (811 mg, 5.87 mmol) in DMSO (45 mL) was stirred for 5 days at 100 °C. After addition of H₂O and ethyl acetate, the layers were separated. The water phase was extracted twice with ethyl acetate, and the combined organic phases were washed with water and brine and dried (MgSO₄). After filtration and removal of the solvent, the residue was purified by silica gel flash chromatography (pentane/ethyl acetate, 8:2) to give the product as a white powder (398 mg, 34 %). HPLC 99%, R_T: 3.27 min (5-99% MeCN over 3 min). ¹H NMR (400 MHz, CH₃OH-*d*₄) δ 1.48 (s, 9 H), 3.21 (br.s, 4 H), 3.71 (s br., 4 H), 7.61 (d, *J* = 6.1 Hz, 1 H), 7.72 (s, 1 H), 8.08 (d, *J* = 5.6 Hz, 1 H). MS (ESI+) *m/z* 398.2 (M+H)⁺.

INTERMEDIATE 57

{4-[4-(*tert*-Butoxycarbonyl)piperazin-1-yl]thieno[3,2-*c*]pyridin-3-yl)sulfonyl}lithium
To a suspension of *tert*-Butyl 4-(3-bromothieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate (4.055 g, 10.18 mmol) in diethyl ether (30 mL) at -78 °C under N₂ atmosphere was added dropwise an 1.6 M solution of *n*-BuLi in hexanes (9.5 mL, 15.2 mmol). After 1 h of stirring, a saturated solution of SO₂ in THF (25 mL) at -78 °C was transferred via a cannula to the mixture. The reaction was allowed to gradually increase to ambient temperature over night. The solvent was evaporated, and the residue was washed with several portions of diethyl ether and then dried under vacuum to give 4.094 g of an off-white solid consisting of 66 % of the title compound and 34 % of (*n*-butylsulfonyl)lithium as by-product. This mixture was used without any further purification in the next step. ¹H NMR (400 MHz, CH₃OH-*d*₄) δ 1.48 (s, 9 H), 3.22 (br.s, 4 H), 3.72 (s br., 4 H), 7.60 (d, *J* = 5.5 Hz, 1 H), 8.06 (d, *J* = 5.5 Hz, 1 H), 8.14 (s, 1 H). MS (ESI+) *m/z* 384.0 (M+H)⁺. HPLC R_T: 2.62 min (5-99% MeCN over 3 min).

INTERMEDIATE 58

***tert*-Butyl-4-[3-(chlorosulfonyl)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate**

To a suspension of ({4-[4-(*tert*-butoxycarbonyl)piperazin-1-yl]thieno[3,2-c]pyridin-3-yl}sulfonyl)lithium (2.751 g, 7.06 mmol (3.126 g of the crude product mixture)) in DCM (40 mL) at 0 °C was added *N*-chlorosuccinimide (1.338 g, 10.0 mmol). After 20 minutes, the temperature was raised to ambient, and the reaction mixture was stirred for an additional 2.5 h. The resulting product solution was washed with water, and the water phase was extracted with DCM. The combined organic extracts were washed with brine and dried over MgSO₄. After filtration and evaporation of the solvent, the residue was

washed with several portions of pentane to yield the product as an off-white solid (2.024 g, 69 %). ¹H NMR (400 MHz, CH₃OH-d₄) δ 1.47 (s, 9 H), 3.11 (br.s, 4 H), 3.2–4.3 (s br., 4 H), 7.68 (d, *J* = 5.5 Hz, 1 H), 8.45 (d, *J* = 5.5 Hz, 1 H), 8.60 (s, 1 H). MS (ESI+) *m/z* 418.2 (M+H)⁺. HPLC 92%, R_T: 3.76 min (5-99% MeCN over 3 min).

INTERMEDIATE 59

***tert*-Butyl-4-(3-[[4-(isopropylphenyl)amino]sulfonyl]thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate**

Prepared from *tert*-butyl 4-[3-(chlorosulfonyl)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate (90.0 mg, 0.215 mmol) and 4-isopropylaniline (37.9 mg, 0.28 mmol) to give the title compound as an off-white solid (58.3 mg, 52 %). ¹H NMR (400 MHz, CDCl₃) δ 1.12 (d, *J* = 7.0 Hz, 6 H), 1.47 (s, 9 H), 2.76 (sept., *J* = 6.9 Hz, 2 H), 3.01–3.53 (m, 6 H), 4.04–4.41 (m, 2 H), 6.79 (d, *J* = 8.5 Hz, 2 H), 6.66 (d, *J* = 8.5 Hz, 2 H), 7.69 (d, *J* = 5.5 Hz, 1 H), 8.23 (s, 1 H), 8.40 (d, *J* = 5.5 Hz, 1 H), 9.90 (s, 1 H). MS (ESI+) *m/z* 517.2 (M+H)⁺. HPLC 97%, R_T: 4.01 min (5-99% MeCN over 3 min).

EXAMPLE 78

***N*-(4-Isopropylphenyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-3-sulfonamide hydrochloride**

Prepared from *tert*-butyl 4-(3-[[4-(isopropylphenyl)amino]sulfonyl]thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate (60.0 mg, 0.116 mmol) which afforded 19 mg (98 %) of the product as a white solid (25.8 mg, 49 %) according to Method H-L. ¹H NMR (400 MHz,

CH₃OH-d₄) δ 1.16 (d, J = 7.0 Hz, 6 H), 2.81 (sept., J = 6.8 Hz, 1 H), 3.59 (s, br., 8 H), 7.00 (d, J = 8.0 Hz, 2 H), 7.10 (d, J = 8.0 Hz, 2 H), 8.07 (s, br., 1 H), 8.37 (s, br., 1 H), 8.50 (s, 1 H). MS (ESI+) m/z 417.2 (M+H)⁺. HPLC 94%, R_T: 3.14 min (5-99% MeCN over 3 min).

5 **EXAMPLE 79**

N-(4-Methylphenyl)-4-(pyrrolidin-3-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride

4-Chloro-*N*-(4-methylphenyl)thieno[3,2-c]pyridine-2-sulfonamide (60.0 mg, 0.17 mmol) in dry DMF (1 mL) and NaH (5.1 mg, 0.21 mmol) was added to pyrrolidin-3-ol (18.5 mg, 0.21 mmol) under nitrogen. The mixture was heated in the microwave at 200°C in 5 min. The product was purified by preparative HPLC. Yield: 29.9 mg (43.4 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.09 (s, 1H) 7.71 (d, J =6.93 Hz, 1 H) 7.46 (d, J =6.93 Hz, 1 H) 7.47-7.44 (m, 4H) 4.67 (d, J =3.22 Hz, 1 H) 3.97 (s, 2 H) 2.26 (s, 3H). LC-MS 390 (M - H)⁺; Purity (HPLC) 99 %.

15

EXAMPLE 80

N-(4-Methylphenyl)-4-(piperidin-4-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride

The synthesis was preformed essentially as described for compound of *N*-(4-methylphenyl)-4-(pyrrolidin-3-yloxy)thieno[3,2-c]pyridine-2-sulfonamide hydrochloride. Yield: 16.2 mg (22.7 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 7.81-7.78 (m, 2H) 7.62 (d, J =6.93 Hz, 1 H) 7.13-7.04 (m, 4H) 4.05-3.94 (m, 1H) 3.90-3.88 (m, 2H) 3.63-3.58 (m, 2H), 2.27 (s, 3H) 2.06-2.03 (m, 2H) 2.01-1.71 (m, 2H); LC-MS 404 (M - H)⁺; Purity (HPLC) 99 %.

25

EXAMPLE 81

N-(2,3-Difluorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

Yield: 74.4 mg (39.2 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.10-8.03 (m, 2H) 7.81 (d, J =6.68 Hz, 1 H) 7.16-7.05 (m, 3H) 4.37 (s, 2 H) 4.11-4.07 (m, 4H) 3.59-3.53 (m, 4H); LC-MS 425 (M - H)⁺; Purity (HPLC) 90 %.

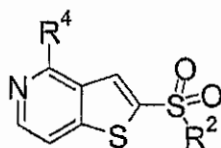
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EXAMPLE 82

N-(3-Chlorobenzyl)-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride

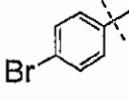
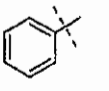
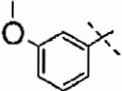
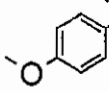
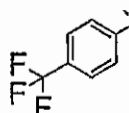
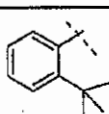
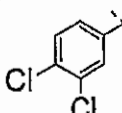
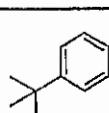
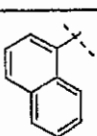
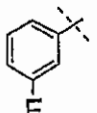
Yield: 74.4 mg (44.7 %). ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 8.04-8.01 7.85 (d, J=6.93 Hz, 1 H) 7.22-7.15 (m, 4H) 4.30 (s, 2 H) 4.14-4.10 (m, 4H) 3.60-3.54 (m, 4H); LC-MS 423 (M - H)⁺; Purity (HPLC) 90%.

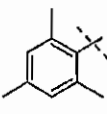
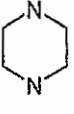
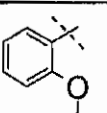
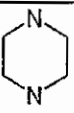
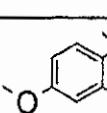
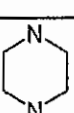
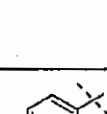
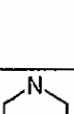
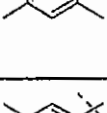
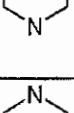
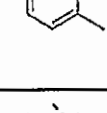
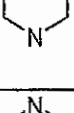
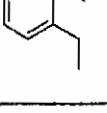
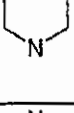
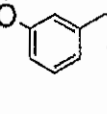
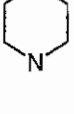
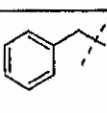
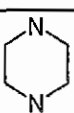
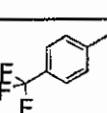
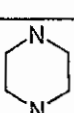
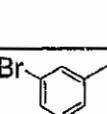
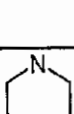
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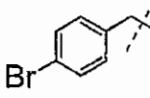
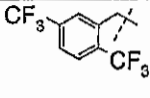
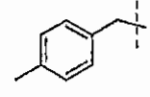
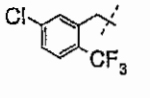
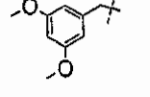
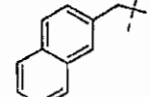
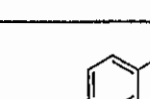
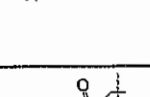
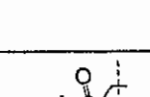
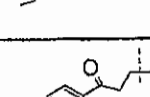


10

EXAMPLE		R ²	R ⁴
83	4-(1,4-Diazepan-1-yl)-2-(phenylsulfonyl)thieno[3,2-c]pyridine hydrochloride		
84	4-(1,4-Diazepan-1-yl)-2-[(3,4-dichlorophenyl)sulfonyl]thieno[3,2-c]pyridine hydrochloride		
85	4-(1,4-Diazepan-1-yl)-2-[1-naphthylsulfonyl]thieno[3,2-c]pyridine hydrochloride		
86	4-(1,4-Diazepan-1-yl)-2-[4-tert-butylphenylsulfonyl]thieno[3,2-c]pyridine hydrochloride		
87	4-(1,4-Diazepan-1-yl)-2-[3,4-dimethylphenylsulfonyl]thieno[3,2-c]pyridine hydrochloride		

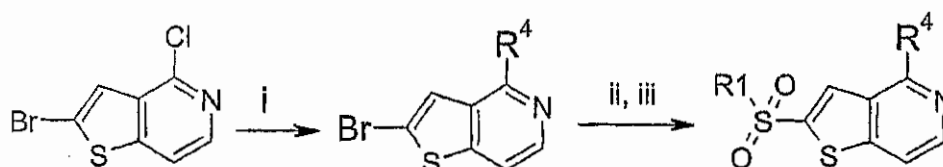
88	2-[(4-Bromophenyl)sulfonyl]-4-(1,4-diazepan-1-yl)thieno[3,2-c]pyridine hydrochloride		
89	2-(Phenylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
90	2-(3-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride		
91	2-(4-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride		
92	4-Piperazin-1-yl-2--{[4-trifluoromethyl]phenyl}sulfonyl}thieno[3,2-c]pyridine hydrochloride		
93	2-[[2-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
94	2-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		
95	2-[(4-tert-Butylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
96	2-(1-Naphthyl sulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
97	2-[(3-Fluorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride		

98	2-(Mesitylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
99	2-[(2-Methoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
100	2-[(2,4-Dimethoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
101	2-[(2,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
102	2-[(2,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
103	2-[(2-Ethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
104	4-(Piperazinyl)-2-(3-methoxybenzyl-sulfonyl)-thienopyridine hydrochloride		
105	2-(Benzylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
106	4-Piperazin-1-yl-2-{[4-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-c]pyridine hydrochloride		
107	2-[(3-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
108	2-[(2,3-Difluorobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		

109	2-[(4-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
110	2-[[2,5-bis(Trifluoromethyl)benzyl]sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
111	2-[(4-Methylbenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
112	2-[[5-Chloro-2-(trifluoromethyl)benzyl]sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
113	2-[(3,5-Dimethoxybenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
114	2-[(2-Naphthylmethyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride		
115	4-Piperazin-1-yl-2-[[4-(1,2,3-thiadiazol-5-yl)benzyl]sulfonyl]thieno[3,2-c]pyridine hydrochloride		
116	1-(4-Pyrrolidin-1-ylphenyl)-2-[(4-piperazine-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] propanone hydrochloride		
117	1-[4-(Diethylamino)phenyl]-2-[(4-piperazine-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] propanone hydrochloride		
118	1-(4-Bromophenyl)-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] propanone		

119	1-(3-Methoxyphenyl)-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl)sulfonyl] propanone		
120	1-Phenyl-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl)sulfonyl]propanone		

Scheme 6



- 5 **Legend to Scheme 6:** i) BOC protected amines (R^4), K_2CO_3 , DMSO; ii) thiophenols (R^1-SH), $Cu_2(I)O$, DMF; iii) $NaOAc$, oxone, water; iv) a. TFA, b. HCl , methanol

INTERMEDIATE 60

***tert*-Butyl 4-(2-bromothieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

- 10 2-Bromo-4-chlorothieno[3,2-*c*]pyridine (5.0 g, 20.24 mmol) and K_2CO_3 (13.97 g, 101.2 mmol) was stirred in DMSO (20 mL) followed by addition of *tert*-butyl piperazine-1-carboxylate (4.14 g, 22.26 mmol). The reaction mixture was stirred at 100 °C for 6 days. The reaction mixture was filtered to eliminate the carbonate and addition of water (50 mL) and ethyl was followed. The phases were separated and the aqueous phase was extracted with ethyl acetate. The combined organic phases were dried ($MgSO_4$) and the solvent was
- 15 evaporated. The crude product was purified by flash chromatography using ethyl acetate/hexanes (2/8) as eluent to give 2 g of the desired product, yield 25%, 99% pure. 1H NMR (270 MHz, $CDCl_3$) δ 1.48 (s, 9H), 1.52-1.63 (m, 1H), 3.42-3.47 (m, 4H), 3.61-3.64 (m, 4H), 7.22 (dd, $J = 5.4$, 1 Hz, 1H), 7.35 (d, $J = 1$ Hz, 1H), 8.04 (d, $J = 5.4$ Hz, 1H). $m/z =$
- 20 398.91 ($M+H$), bromide pattern.

INTERMEDIATE 61

***tert*-butyl 4-(2-bromothieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

The same procedure above intermediate was used starting from 2-bromo-4-chlorothieno[3,2-*c*]pyridine (7.5 g, 30.45 mmol), K₂CO₃ (6.7 g, 33.5 mmol) and *tert*-butyl 1,4-diazepane-1-carboxylate (21.0 g, 152.2 mmol) in DMSO (30 mL). Purification by flash chromatography 3.04 g of the title compound (Yield 25%). HPLC purity 92%; ¹H NMR (270 MHz, CDCl₃) δ 1.38 (s, 4.5 H), 1.43 (s, 4.5 H), 1.96-2.11 (m, 2H), 3.36-3.41 (m, 1H), 3.46-3.51 (m, 1H), 3.65-3.87 (m, 6H), 7.02-7.04 (m, 1H), 7.40-7.42 (m, 1H), 7.94 (d, J= 5.4 Hz, 1H). m/z = 411.97 (M+H).

Coupling with thiophenols (Method M)

INTERMEDIATE 62

***tert*-butyl 4-(2-phenylthio)thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

tert-Butyl 4-(2-bromothieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (0.31 g, 0.752 mmol), pulverized KOH (0.084 g, 1.5 mmol) and Cu₂(I)O (0.1 g, 0.75 mmol) was mixed with DMF (1 mL) before the addition of a solution of benzenethiol (0.16 g, 1.5 mmol) in DMF (1 mL). The reaction mixture was heated to 120 °C for 15 h. The reaction mixture was poured in a silica plug and eluted with chloroform, to give the crude product. The crude product was purified by flash chromatography using ethyl acetate/hexanes (2/8) as eluent to give 0.21 g of the desired product, yield 64%, 90% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.37 (s, 4.5H), 1.43 (s, 4.5 H), 1.97-2.10 (m, 2H), 3.36-3.43 (m, 1H), 3.46-3.53 (m, 1H), 3.64-3.73 (m, 2H), 3.78-3.96 (m, 4H), 7.05 (d, J= 5.4 Hz, 1H), 7.22-7.32 (m, 5H), 7.59-7.63 (m, 1H), 7.97 (d, J= 5.4 Hz, 1H). m/z = 442.15 (M+H).

Oxidation of thio-derivatives (Method N)

INTERMEDIATE 63

***tert*-Butyl 4-(2-phenylsulfonyl)thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

A solution of *tert*-Butyl 4-(2-phenylthio)thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (0.21 g, 0.48 mmol) and NaOAc (0.5 g) in ethanol (10 mL), (pH ~5) followed by the addition of Oxone (0.64 g, 1.04 mmol) dissolved in water (1 mL). The reaction

mixture was stirred at RT for 16 h. Additional Oxone (0.32 g) in water (1mL) was added. Full conversion of the SM was obtained after 8 h. Water (50 mL) and chloroform (30 mL) were added. The phases were separated and the aqueous phase was extracted with chloroform. The combined organic phases were dried over (MgSO₄), the solvent was
5 evaporated to give the crude product which was purified by reverse-phase chromatography (10→90), to give 0.191 g of the desired product as yellow oil (Yield 86%) 98% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.28 (s, 4.5 H), 1.38 (s, 4.5 H), 1.99-2.03 (m, 2H), 3.31-3.40 (m, 1H), 3.42-3.47 (m, 1H), 3.63-3.69 (m, 2H), 3.85-3.98 (m, 4H), 7.02 (d, J= 5.4 Hz, 1H), 7.48-7.61 (m, 3H), 7.76-8.01 (m, 3H), 8.06-8.08 (m, 1H). m/z = 474.01 (M+H).

10

Removal of the *t*-butyl-carboxylate protecting group (Method O)

EXAMPLE 83

4-(1,4-Diazepan-1-yl)-2-(phenylsulfonyl)thieno[3,2-*c*]pyridine hydrochloride

tert-Butyl 4-(2-phenylsulfonyl)thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate
15 (0.165 g, 0.348 mmol) was dissolved in DCM (2 mL) and TFA (1 mL) was added. The reaction mixture was stirred for 2 h. The solvent was evaporated. Methanol and HCl in ether was added (x 3) to give 0.118 g of the desired HCl salt, yield 85%, 98% pure. ¹H NMR (270 MHz, CHOH-d₄) δ 2.45-2.52 (m, 2H), 3.45-3.52 (m, 2H), 3.70-3.79 (m, 2H), 4.18-4.22 (m, 2H), 4.30-4.40 (m, 2H), 7.62-7.76 (m, 5H), 7.91 (d, J = 5.4 Hz, 1H), 8.11
20 (dd, J= 5.4, 1 Hz, 1H), 8.41 (d, J= 1 Hz, 1H). m/z = 374.09 (M+H-HCl).

INTERMEDIATE 64

tert-Butyl 4-[2-(4-*tert*-butylphenyl)thio]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate

25 The product was prepared according to Method M. Purification by flash chromatography using ethyl acetate/hexanes (2/8) as eluent gave 0.035 g, 99% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.28 (s, 9H), 1.38 (s, 4.5 H), 1.43 (s, 4.5 H), 1.98-2.03 (m, 2H), 3.35-3.41 (m, 1H), 3.46-3.52 (m, 1H), 3.62-3.72 (m, 2H), 3.77-3.93 (4H), 7.04 (d, J= 5.4 Hz, 1H), 7.27-7.34 (m, 4H), 7.54-7.56 (m, 1H), 7.95 (d, J= 5.4 Hz, 1H). m/z = 498.0 (M+H).

30

INTERMEDIATE 65

***tert*-Butyl 4-[2-(4-*tert*-butylphenyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

Procedure B from *tert*-butyl 4-[2-(4-*tert*-butylphenyl)thio]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (0.035 g, 0.070 mmol), Oxone (0.17 g, 0.28 mmol), NaOAc (0.5 g) in EtOH (2 mL) followed by reversed phase chromatography (40→70), gave 6 mg of the product. Yield 17%, 98% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.32 (s, 9H), 1.35 (s, 9H), 2.05-2.15 (m, 2H), 3.45-3.62 (m, 2H), 3.75-4.13 (m, 6H), 7.20-7.27 (m, 5H), 7.58 (d, J= 10.8 Hz, 1H), 7.93 (d, J= 10.8 Hz, 1H). m/z = 530.0 (M+H).

INTERMEDIATE 66

***tert*-Butyl 4-[2-(3,4-dimethylphenyl)thio]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

The title compound was obtained according to Method M. Purification by flash chromatography using ethyl acetate/hexanes (2/8) as eluent gave 0.022 g, 95% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.38 (s, 4.5 H), 1.43 (s, 4.5 H), 1.96-2.04 (m, 2H), 2.21 (s, 3H), 2.22 (s, 3H), 3.37-3.45 (m, 2H), 3.47-3.50 (m, 2H), 3.77-3.95 (m, 4H), 7.01-7.12 (m, 3H), 7.16 (s, 1H), 7.53 (dd, J= 5.4, 1 Hz, 1H), 7.94 (d, J= 5.4 Hz, 1H). m/z = 470.3 (M+H).

INTERMEDIATE 67

***tert*-Butyl 4-[2-(3,4-dimethylphenyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate**

Procedure B from *tert*-Butyl 4-[2-(3,4-dimethylphenyl)thio]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (0.022 g, 0.047 mmol); OXONE (0.11 g, 0.19 mmol); NaOAc (0.5 g) in EtOH (2 mL) followed by reversed phase chromatography (40→70), 9 mg of the product. Yield 38%, 92% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.35 (s, 9H), 2.08-2.20 (m, 2H), 2.33 (s, 6H), 3.52-3.59 (m, 2H), 3.83-3.88 (m, 2H), 4.08-4.18 (m, 4H), 7.21-7.28 (m, 2H), 7.31-7.35 (m, 1H), 7.73-7.75 (m, 2H), 8.02 (d, J= 5.4 Hz, 1H). m/z = 502.21 (M+H).

INTERMEDIATE 68

***tert*-Butyl 4-[2-(1-naphthyl)thio]thieno[3,2-*c*]pyridin-4-yl]-1,4-diazepane-1-carboxylate**

The title compound was obtained according to Method M. Purification by flash chromatography using ethyl acetate/hexanes (2/8) as eluent gave 0.055 g. HPLC purity 99 %; ¹H NMR (270 MHz, CDCl₃) δ 1.37 (s, 4.5 H), 1.43 (s, 4.5 H), 1.89-2.20 (m, 2H), 3.30-3.40 (m, 1H), 3.43-3.50 (m, 1H), 3.60-3.90 (m, 6H), 6.99 (d, J= 5.4 Hz, 1H), 7.39 (dd, J= 8.1, 1 Hz, 1H), 7.50-7.61 (m, 5H), 7.79-7.88 (m, 2H), 7.92 (d, J= 5.4 Hz, 1H), 8.40-8.44 (m, 1H). *m/z* = 498.26 (M+H).

INTERMEDIATE 69

***tert*-Butyl 4-[2-(1-naphthyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl]-1,4-diazepane-1-carboxylate**

Procedure B from *tert*-Butyl 4-[2-(1-naphthyl)thio]thieno[3,2-*c*]pyridin-4-yl]-1,4-diazepane-1-carboxylate (0.055 g, 0.112 mmol); Oxone (0.27 g, 0.448 mmol); NaOAc (0.5 g) in EtOH (2 mL) followed reversed phase chromatography (40→70) gave 15 mg of the product. Yield 26%, 93% pure. ¹H NMR (270 MHz, CDCl₃) δ 1.34 (s, 9H), 2.06-2.10 (m, 2H), 3.48-3.62 (m, 2H), 3.78-3.86 (m, 2H), 3.95-4.16 (m, 4H), 7.19-7.31 (m, 2H), 7.60-7.75 (m, 3H), 7.92-7.99 (m, 2H), 8.18 (m, J= 8.1 Hz, 1H), 8.50-8.53 (m, 1H), 8.77-8.80 (m, 1H). *m/z* = 524.22 (M+H);

EXAMPLE 84

4-(1,4-Diazepan-1-yl)-2-[(3,4-dichlorophenyl)sulfonyl]thieno[3,2-*c*]pyridine hydrochloride

tert-Butyl 4-{2-[(3,4-dichlorophenyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}-1,4-diazepane-1-carboxylate was prepared from 3,4-dichlorothiophenol (60 mg, 15%), as a beige solid, by the application of the general procedures A and B described above. ¹H NMR (CDCl₃) δ 8.27-8.14 (m, 1H), 8.11-8.04 (m, 2H), 7.87-7.80 (m, 1H), 7.67-7.62 (m, 1H), 7.26-7.20 (m, 1H), 4.18-3.98 (m, 4H), 3.87-3.74 (m, 2H), 3.61-3.44 (m, 2H), 2.20-2.00 (m, 2H), 1.33 (s, 9H); MS *m/z* 542 (M+1). The title compound (50 mg, 95%) was obtained as a beige solid, by the application of the general procedure C described above. ¹H NMR (270 MHz,

CH₃OH-d₄) δ 8.48 (s, 1H), 8.30 (d, J = 1.85 Hz, 1H), 8.05 (dd, J = 8.58, 1.98 Hz, 1H), 7.92 (d, J = 6.86 Hz, 1H), 7.83 (d, J = 8.44 Hz, 1H), 7.69 (d, J = 6.86 Hz, 1H), 4.4-4.34 (m, 2H), 4.24-4.16 (m, 2H), 3.76-3.69 (m, 2H), 3.51-3.43 (m, 2H), 2.52-2.42 (m, 2H); MS m/z 442 (M+1).

5

EXAMPLE 85

4-(1,4-Diazepan-1-yl)-2-[1-naphthylsulfonyl]thieno[3,2-*c*]pyridine hydrochloride

The title compound was obtained from *tert*-butyl 4-[2-(1-naphthyl)sulfonyl]thieno-[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (15 mg, 0.029 mmol) following Method O to give 12 mg of the desired product yield 90 %, 95 % pure. ¹H NMR (270 MHz, CH₃OH-d₄) δ 2.40-2.50 (m, 2H), 3.45-3.55 (m, 2H), 3.65-3.75 (m, 2H), 4.06-4.26 (m, 2H), 4.27-4.46 (m, 2H), 7.58-7.80 (m, 4H), 7.83-7.86 (m, 1H), 8.06 (d, J = 8.1 Hz, 1H), 8.20 (d, J = 8.1 Hz, 1H), 8.48 (s, 1H), 8.53-8.56 (m, 1H), 8.83-8.86 (m, 1). m/z = 424.06 (M+H-HCl).

15 EXAMPLE 86

4-(1,4-Diazepan-1-yl)-2-[4-*tert*-butylphenylsulfonyl]thieno[3,2-*c*]pyridine hydrochloride

The title compound was obtained from *tert*-butyl 4-[2-(4-*tert*-butylphenyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (6 mg, 11.3 mmol) following Method O to give 4 mg of the desired product, yield 76 %, 88 % pure. ¹H NMR (270 MHz, CH₃OH-d₄) δ 1.33 (s, 9H), 2.41-2.47 (m, 2H), 3.41-3.49 (m, 2H), 3.65-3.78 (m, 2H), 4.15-4.25 (m, 2H), 4.29-4.40 (m, 2H), 7.65-7.70 (m, 3H), 7.90 (d, J = 5.4 Hz, 1H), 8.00-8.04 (m, 2H), 8.37 (s, 1H). m/z = 430.06 (M+H-

25 EXAMPLE 87

4-(1,4-Diazepan-1-yl)-2-[3,4-dimethylphenylsulfonyl]thieno[3,2-*c*]pyridine hydrochloride

The title compound was obtained from *tert*-butyl 4-[2-(3,4 dimethylphenyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl)-1,4-diazepane-1-carboxylate (6 mg, 0.012 mmol) following Method O to give 6 mg of the desired product, yield 88 %, 89 % pure. ¹H NMR (270 MHz, CH₃OH-d₄) δ 2.34 (s, 6H), 2.45-2.55 (m, 2H), 3.42-3.51 (m, 2H), 3.67-3.76 (m,

2H), 4.10-4.20 (m, 2H), 3.58-3.70 (m, 2H), 7.39-7.41 (m, 1H), 7.64-7.67 (m, 1H), 7.79-7.84 (m, 2H), 7.89-7.91 (m, 1H), 8.36 (s, 1H). $m/z = 402.07$ (M+H-HCl).

EXAMPLE 88

5 **2-[(4-Bromophenyl)sulfonyl]-4-(1,4-diazepan-1-yl)thieno[3,2-c]pyridine hydrochloride**

Trifluoroacetic acid (1 mL) was added slowly to a solution of *tert*-butyl 4-{2-[(4-bromophenyl)thio]thieno[3,2-c]pyridin-4-yl}-1,4-diazepane-1-carboxylate (26 mg, 0.047 mmol) in CH_2Cl_2 at 0 °C. The reaction mixture was allowed to reach room temperature, stirred for 40 min and then concentrated *in vacuo*. The residue was twice re-dissolved in MeOH and concentrated *in vacuo*. The residue was again dissolved in MeOH and an excess of 1M HCl in diethyl ether (4 mL) was slowly added to the solution. Removal of the solvents *in vacuo* afforded the title compound (21 mg, 91 %) as a yellowish solid. ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ 8.41 (s, 1H), 8.06-7.99 (m, 2H), 7.92 (d, $J = 6.86$ Hz, 1H), 7.87-7.80 (m, 2H), 7.66 (d, $J = 6.86$ Hz, 1H), 4.38-4.31 (m, 2H), 4.22-4.14 (m, 2H), 3.74-3.67 (m, 2H), 3.50-3.42 (m, 2H), 2.51-2.39 (m, 2H); MS m/z 452 (M+1).

EXAMPLE 89

2-(Phenylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

20 To a stirred solution of *tert*-butyl 4-[2-(phenylthio)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate (350 mg, 0.819 mmol) in ethanol was added oxone in water solution. The reaction was monitored by LCMS. When all starting material was consumed, the chromatogram showed two major peaks, the product and the N-oxide. After purification by preparative HPLC, the resulting Boc-material was treated with HCl in ether. The solution was centrifugated and the supernatant was removed. Ether was added, then centrifugated and decanted (repeated three times) to remove the excess HCl. The remaining ether was finally evaporated in a SpeedVac concentrator. Yield 18 %, HPLC purity = 98%, $m/z = 360.0$ (M+H). ^1H NMR (270 MHz, $\text{CH}_3\text{OH}-d_4$) δ ppm 3.56 (m, 4 H) 4.08 (m, 4 H) 7.68 (m, 4 H) 7.77 (dd, $J = 6.60, 0.79$ Hz, 1 H) 8.04 (d, $J = 6.33$ Hz, 1 H) 8.12 (m, 2 H) 8.39 (d, $J = 0.79$ Hz, 1 H).

EXAMPLE 90

2-(3-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride
4-[2-(3-Methoxy-phenylsulfanyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-

1-carboxylic acid *tert*-butyl ester was obtained from 3-methoxythiophenol (130 μ l, 1
5 mmol) and *tert*-Butyl 4-(2-bromothieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate (215
mg, 0.52 mmol). 120 mg, 50%) were obtained by the application of the general Method M
described above. ^1H NMR (270 MHz, CDCl_3) δ 1.48 (s, 9 H), 3.42-3.51 (m, 4 H), 3.58-
3.67 (m, 4 H), 3.74 (s, 3 H), 6.76 (dd, $J=8.18, 2.38$ Hz, 1 H), 6.84-6.92 (m, 2 H), 7.16-7.23
(m, 2 H), 7.51 (s, 1 H), 8.04 (d, $J=5.81$ Hz, 1 H); MS m/z 458 (M+1). The title compound
10 was therefore obtained from 4-[2-(3-methoxy-phenylsulfanyl)-thieno[3,2-c]pyridin-4-yl]-
piperazine-1-carboxylic acid *tert*-butyl (7 mg, 7%), after triturating with diethyl ether, as a
beige solid, by the application of the general procedures B and C described above. ^1H
NMR (270 MHz, CD_3OD) δ 8.31 (s, 1H), 8.09 (d, $J = 6.33$ Hz, 1H), 7.71-7.62 (m, 2H),
7.59-7.50 (m, 2H), 7.30-7.23 (m, 1H), 3.98-3.92 (m, 4H), 3.87 (s, 3H), 3.54-3.48 (m, 4H);
15 MS m/z 390 (M+1).

EXAMPLE 91

2-(4-Methoxy-benzenesulfonyl)-4-piperazin-1-yl-thieno[3,2-c]pyridine hydrochloride
4-[2-(4-Methoxy-phenylsulfanyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-

1-carboxylic acid *tert*-butyl ester was obtained from 4-methoxythiophenol (130 μ l, 1
20 mmol) and *tert*-butyl 4-(2-bromothieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate (215
mg, 0.52 mmol). 100 mg, 42% were isolated by the application of the general Method M
described above. ^1H NMR (270 MHz, CDCl_3) δ 1.48 (s, 9 H), 3.40-3.47 (m, 4 H), 3.58-
3.65 (m, 4 H), 3.79 (s, 3 H), 6.83-6.89 (m, 2 H), 7.15 (d, $J=5.54$ Hz, 1 H), 7.35 (s, 1 H),
25 7.38-7.43 (m, 2 H), 7.99 (d, $J=5.81$ Hz, 1 H); MS m/z 458 (M+1).
4-[2-(4-methoxy-phenylsulfanyl)-thieno[3,2-c]pyridin-4-yl]-piperazine-1-carboxylic acid
tert-butyl ester was obtained (25 mg, 23%) as a clear liquid by the application of the
general procedure B described above. ^1H NMR (270 MHz, CDCl_3) δ 1.48 (s, 9 H), 3.67-
3.91 (m, 11 H), 7.01 (d, $J = 8.97$ Hz, 2H), 7.27-7.37 (m, 1H), 7.93 (d, $J = 8.97$ Hz, 2H),
30 8.01-8.19 (m, 2H); MS m/z 490 (M+1). The title compound was thereby obtained
following Procedure C): ^1H NMR (CD_3OD) δ 8.25 (s, 1H), 8.09-7.89 (m, 3H), 7.69 (d, $J =$

6.33 Hz, 1H), 7.17-7.10 (m, 2H), 4.00-3.93 (m, 4H), 3.87 (s, 3H), 3.55-3.48 (m, 4H); MS m/z 390 ($M+1$).

EXAMPLE 92

5 **4-Piperazin-1-yl-2-[[4-trifluoromethyl]phenyl]sulfonyl]thieno[3,2-c]pyridine hydrochloride**

2-[[4-(Trifluoromethyl)phenyl]thio]-4-piperazin-1-ylthieno[3,2-c]pyridine (0.42 mmol) was dissolved in TFA (1.5 mL) at 0°C, stirred for 15 min and H₂O₂ (100 µL) was added. The mixture was stirred at room temperature over night. NaOH (2 M) was added,
10 extraction with ethyl acetate (3X), washed with brine, dried over NaSO₄. The solvent was removed and the product was purified by preparative HPLC to afford 154.7 mg (86.2 %).
¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.79 (s, 1H) 8.56 (s, 1 H) 8.35 (d, $J=8.44$ Hz, 2 H) 8.12-8.05 (m, 3H) 7.79 (d, $J=6.33$ Hz, 1 H) 3.98-3.96 (m, 4H) 3.32-3.31 (m, 4H); LC-MS 428 ($M - H$)⁺; Purity (HPLC) 95%

15

EXAMPLE 93

2-[[2-*tert*-Butylphenyl]sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The title compound was prepared following Method M-O. Yield: 10.6 mg (6.3 %) of 2-[[2-*tert*-butylphenyl]sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride. ¹H NMR
20 (270 MHz, DMSO-d₆) δ ppm 9.57 (s, 1 H) 8.42 (s, 1 H) 8.26-8.22 (m, 1H) 8.06-8.04 (m, 1H) 7.68-7.55 (m, 4H) 3.87-3.86 (m, 4H) 3.34-3.33 (m, 4H) 1.51-1.43 (m, 9H); LC-MS 400 ($M - H$)⁺; Purity (HPLC) 90%.

EXAMPLE 94

25 **2-[(3,4-Dichlorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine-2-sulfonamide hydrochloride**

The title compound was prepared following Method M-O. Yield: 47.9 mg (22.9 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.36 (s, 1 H) 8.51 (s, 1 H) 8.38 (d, $J=2.11$ Hz, 1 H) 8.06-7.94 (m, 3H) 7.70-7.68 (m, 1H) 3.81-3.77 (m, 4H) 3.31-3.29 (m, 4H); LC-MS 427 ($M - H$)⁺; Purity (HPLC) 95 %.

30

EXAMPLE 95

2-[(4-*tert*-Butylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-*c*]pyridine hydrochloride

Oxone (0.52 g, 0.84 mmol) in water (4 mL), buffered to pH ~ 6 with sodium oxide acetate, was added to 2-[(4-*tert*-butylphenyl)thio]-4-piperazin-1-ylthieno[3,2-*c*]pyridine (0.42
5 mmol) in ethanol (30 mL). The mixture was stirred in room temperature for 2 h and more oxone (0.52 g, 0.84 mmol) was added. The reaction was stirred over night. Water was added to the mixture, extraction with dichloromethane (2X 20 mL) and the solvent was removed. The products were purified by preparative HPLC. Yield: 41.9 mg (22.0%). ¹H NMR (500 MHz, CH₃OH-*d*₄) δ ppm 8.38 (s, 1 H) 8.05-8.01 (m, 3H) 7.80 (d, *J*=6.59 Hz, 1
10 H) 7.71-7.69 (m, 2H) 4.15-4.13 (m, 4H) 3.59-3.57 (4H) 1.37-1.33 (m, 9H); LC-MS 416 (M - H)⁺; Purity (HPLC) 95%.

EXAMPLE 96

2-(1-Naphthylsulfonyl)-4-piperazin-1-ylthieno[3,2-*c*]pyridine hydrochloride

15 The title compound was prepared following Method M-O. Yield: 3.4 mg (0.2 %). ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 9.34 (s, 1 H) 8.82 (s, 1 H) 8.44 (s, 1 H) 8.26-8.06 (m, 5H) 7.79-7.65 (m, 3H) 3.79-3.78 (m, 4H) 3.32-3.30 (m, 4H); LC-MS 410 (M - H)⁺; Purity (HPLC) 95%.

20 EXAMPLE 97

2-[(3-Fluorophenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-*c*]pyridine-2-sulfonamide hydrochloride

2-Bromo-4-chlorothieno[3,2-*c*]pyridine (190 mg, 0.50 mmol) in DMF (1 mL) was added to 3-fluorobenzenethiol (95.5 mg, 1.0 mmol), KOH (56 mg, 0.2 mmol) and Cu₂O (71 mg,
25 0.5 mmol) in DMF (1 mL). The reaction was heated to 120°C over night. The mixture was filtrated through a silica plug and the solvent was removed. The product was dissolved in TFA (1.5 mL) at 0°C and the solution were stirred for 15 min, H₂O₂ (100 μL) was added and the mixture was stirred at room temperature over night. 2M NaOH was added, extraction with etylacetate, washed with brine and solvent was removed. The product was
30 purified by preparative HPLC. Yield: 30.1 mg (16.1%) ¹H NMR (270 MHz, DMSO-*d*₆) δ ppm 9.34 (s, 1 H) 8.45 (s, 1 H) 8.16 (d, *J*=5.69 Hz, 1 H) 7.97-7.93 (m, 2H) 7.76-7.62 (m,

3H) 3.30 (s, 4 H) (4H obscured by solvent signal); LC-MS 378 (M - H)⁺; Purity (HPLC) 99%.

EXAMPLE 98

5 **2-(Mesitylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride**

The title compound was prepared following Method M-O. Yield: 32.0 mg (16.1 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.32 (s, 1 H) 8.20-8.14 (m, 2H) 7.66 (d, J=5.69 Hz, 1 H) 7.14 (s, 2 H) 3.29 (s, 4 H) 2.65 (s, 6H) 2.28 (s, 3H) (4H obscured by solvent signal); LC-MS 402 (M - H)⁺; Purity (HPLC) 95%.

10

EXAMPLE 99

2-[(2-Methoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The title compound was prepared following Method M-O. Yield: 14.7 mg (7.6 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.33 (s, 1 H) 8.24 (s, 1 H) 8.15 (d, J=5.94 Hz, 1 H) 15 8.00 (dd, J=7.92, 1.48 Hz, 1 H) 7.77-7.68 (m, 2H) 7.28-7.18 (m, 2H) 3.30 (s, 4H) (7H obscured by solvent signal); LC-MS 390 (M - H)⁺ Purity (HPLC) 99%.

EXAMPLE 100

20 **2-[(2,4-Dimethoxyphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride**

The title compound was prepared following Method M-O. Yield: 42.7 mg (20.5 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.39 (s, 1 H) 8.37 (s, 1 H) 8.13 (d, J=5.69 Hz, 1 H) 7.68-7.66 (m, 2H) 7.54 (d, J=2.23 Hz, 1 H) 7.19 (d, J=8.66 Hz, 1 H) 3.29 (s, 4 H) (10H obscured by solvent signal); LC-MS 420 (M - H)⁺; Purity (HPLC) 98%.

25

EXAMPLE 101

2-[(2,4-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The title compound was prepared following Method M-O. Yield: 17.8 mg (9.3 %). ¹H NMR (270 MHz, DMSO-d₆) δ ppm 9.32 (s, 1H) 8.27 (s, 1 H) 8.15 (d, J=5.94 Hz, 1 H) 30 8.00 (d, J=8.17 Hz, 1 H) 7.67 (d, J=5.94 Hz, 1 H) 7.35-7.26 (m, 2H) 3.29 (s, 4H) 2.34 (s, 3H) (7H obscured by solvent signal); LC-MS 388 (M - H)⁺ Purity (HPLC) 98%.

EXAMPLE 102

2-[(2,5-Dimethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The title compound was prepared following Method M-O. Yield: 16.9 mg (8.8 %). ¹H

- 5 NMR (270 MHz, DMSO-d₆) δ ppm 9.17 (s, 1 H) 8.29 (s, 1 H) 8.18-18.15 (m, 1H) 7.94 (s, 1 H) 7.66 (d, *J*=5.69 Hz, 1 H) 7.47 (d, *J*=7.67 Hz, 1 H) 7.32 (d, *J*=8.16 Hz, 1 H) 3.29 (s, 2 H) 2.42 (s, 3 H) (7H obscured by solvent signal); LC-MS 388 (M - H)⁺; Purity (HPLC) 99%.

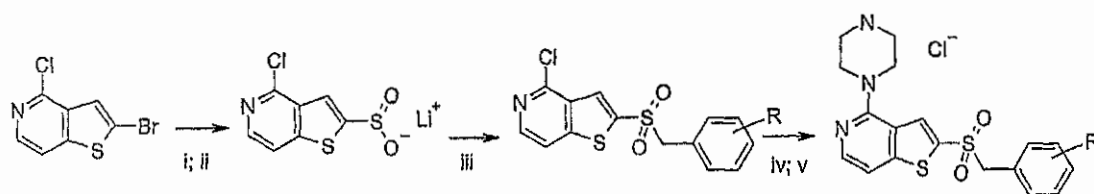
10 EXAMPLE 103

2-[(2-Ethylphenyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The title compound was prepared following Method M-O. Yield: 22.6 mg (11.2 %). ¹H

- 15 NMR (270 MHz, DMSO-d₆) δ ppm 9.19 (s, 1 H) 8.32 (s, 1 H) 8.17 (d, *J*=5.69 Hz, 1 H) 8.08 (d, *J*=7.92 Hz, 1 H) 7.73-7.66 (m, 2H) 7.52 (t, *J*=7.67 Hz, 2 H) 3.29 (s, 4 H) 3.00 (q, *J*=7.34 Hz, 2 H) 1.10 (m, 3 H) (4H obscured by solvent signal); LC-MS 388 (M - H)⁺; Purity (HPLC) 100%.

Scheme 7



Legend to Scheme 7: i) nBuLi, diethyl ether; ii) SO₂ gas; iii) benzylbromide(s), DMF, heat; iv) diamine(s), K₂CO₃, DMF, heat; v) HCl, diethyl ether.

INTERMEDIATE 70

25 **Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate**

2-Bromo-4-chlorothieno[3,2-c]pyridine (5.00 g, 20.1 mmol) was suspended in dry ether (100 ml) and the mixture was cooled to -78 °C under N₂-atmosphere. n-BuLi (1.6M in hexane, 15 mL) was added and the reaction mixture was stirred at -78 °C for 2h. SO₂ (g) was then bubbled through the reaction mixture for 1h. After the gas bubbling had stopped the

reaction mixture was stirred for one more hour at $-78\text{ }^{\circ}\text{C}$ and was then allowed to warm to room temperature. The precipitate that had formed was filtered and washed with ether to give the sulfonate lithium salt (3.59 g, 74 %) that was used in the next step without further purification. ^1H NMR (270 MHz, $\text{DMSO-}d_6$) δ ppm 7.26 (s, 1 H) 7.99 (d, $J=5.54$ Hz, 1 H) 8.14 (d, $J=5.54$ Hz, 1 H). MS ($M\text{-Li}+1$) 234.

Benzylation of sulfinate salts (Method P)

To a suspension of lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (100 mg, 0.42 mmol) in dry DMF (2 mL) was added a benzylbromide (0.83 mmol, 2 equiv.) and the mixture heated with stirring for 16 h at $110\text{ }^{\circ}\text{C}$. Analysis by LCMS showed desired product and no starting material remaining. The mixture was treated with polystyrene-thiophenol (200 mg) and was rolled for 16 h. The suspension was filtered washing with further DMF (2 mL). This material was reacted further without purification.

Nucleophilic substitution of chlorine (Method Q)

To a crude solutions of benzylsulfone in DMF (4 mL) are added potassium carbonate (172 mg, 1.25 mmol) and *tert*-butyl-piperazine-1-carboxylate (155 mg, 0.84 mmol). The resulting mixtures are heated for 16 h at $110\text{ }^{\circ}\text{C}$. LCMS shows desired compound and no starting material. The reaction mixtures are filtered and then the solvent removed under reduced pressure. The desired compounds are isolated pure following preparative HPLC.

BOC-deprotection (Method R)

The BOC N-protected piperazine derivatives are dissolved in HCl / diethyl ether (1 mL, 1.0M) at room temperature and stirred for 16 h. Removal of the solvent under reduced pressure gave the crude hydrochloride salts. Trituration with acetonitrile gives the desired compound as a white solid.

INTERMEDIATE 71

tert-Butyl-4-[2-(benzylsulfonyl)thieno[3,2-*c*]pyridin-4-yl]piperazine-1-carboxylate

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.009 g (7 % over two

steps). ¹H NMR (300 MHz, CDCl₃) δ 8.14 (d, *J*=5.5 Hz 1 H), 7.27-7.40 (m, 5 H), 7.15-7.21 (m, 2 H), 4.45 (s, 2 H), 3.50-3.56 (m, 4 H), 3.40-3.45 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₃ H₂₇ N₃ O₄ S₂ *m/z* 474 (M+H)⁺. HPLC 77%, R_T 3.93 min (ACE3 C8 50x4mm, 5-50% acetonitrile in 3 min).

5

INTERMEDIATE 72

***tert*-Butyl-4-(2-{[4-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 4-(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method QF. Yield 0.02 g (16 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*=6 Hz 1 H), 7.53-7.61 (d, *J*=9 Hz 2 H), 7.49 (s, 1 H), 7.26-7.36 (m, 4 H), 4.51 (s, 2 H), 3.49-3.60 (m, 4 H), 3.36-3.49 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄ H₂₆ F₃ N₃ O₄ S₂ *m/z* 542 (M+H)⁺. HPLC 71 %, R_T 4.07min (ACE3 C8 50x4mm, 5-50% acetonitrile in 3 min).

15

INTERMEDIATE 73

***tert*-Butyl-4-{2-[(3-bromobenzyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 3-bromobenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.023 g (10 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*=6 Hz, 1H), 7.50-7.55 (m, 2 H), 7.32-7.40 (m, 2 H), 7.10-7.24 (m, 3 H), 4.44 (s, 2 H), 3.61-3.73 (m, 8 H), 1.50 (s, 9 H); MS (ESI+) for C₂₃ H₂₆ Br N₃ O₄ S₂ *m/z* 554 (M+H)⁺. HPLC 77 %, R_T 4.07min (ACE3 C8 50x4.6mm, 5-50% acetonitrile in 3 min).

25

INTERMEDIATE 74

***tert*-Butyl-4-(2-{[3-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

30

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 3-(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then

reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.023 g (10 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.14 (d, *J*= 6 Hz, 1 H), 7.85-7.91 (m, 1 H), 7.61-7.72 (m, 2 H), 7.50-7.60 (m, 1 H), 7.12-7.31 (m, 2 H), 4.74 (s, 2 H), 3.52-3.71 (m, 8 H), 1.50 (s, 9 H); MS (ESI+) for C₂₄ H₂₆ F₃ N₃ O₄ S₂ *m/z* 542 (M+H)⁺. HPLC 85 %, R_T 2.13min (YMC ODS AQ, 33x3mm, 10-90% acetonitrile in 3 min).

INTERMEDIATE 75

10 *tert*-Butyl-4-(2-([2,5-bis(trifluoromethyl)benzyl]sulfonyl)thieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 2,5-bis(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.01 g (4 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*= 5.8 Hz 1 H), 8.00 (s, 1 H), 7.74-7.85 (m, 3 H), 4.76 (s, 2 H), 3.56-3.64 (m, 4 H), 3.47-3.56 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₅ H₂₅ F₆ N₃ O₄ S₂ *m/z* 610 (M+H)⁺. HPLC 73 %, R_T 2.36min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

INTERMEDIATE 76

20 *tert*-Butyl 4-{2-[(4-methylbenzyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}piperazine-1-carboxylate

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 4-methylbenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.005 g (3 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.15 (d, *J*= 6 Hz 1 H), 7.40 (s, 1 H), 7.00-7.16 (m, 4 H), 4.42 (s, 2 H), 3.46-3.60 (m, 4 H), 3.37-3.46 (m, 4 H), 2.34 (s, 3 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄ H₂₉ N₃ O₄ S₂ *m/z* 488 (M+H)⁺. HPLC 69 %, R_T 2.06min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

INTERMEDIATE 77

***tert*-Butyl 4-(2-{[5-chloro-2-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 5-chloro-2-(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.019 g (7.5 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.12-8.14 (m, 1 H), 7.80-7.88 (m, 2 H), 7.47-7.66 (m, 2 H), 4.71 (s, 2 H), 3.74-3.83 (m, 4 H), 3.63-3.72 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄ H₂₅ Cl F₃ N₃ O₄ S₂ *m/z* 576 (M+H)⁺. HPLC 74 %, R_T 2.30min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

INTERMEDIATE 78

***tert*-Butyl 4-{2-[(3,4-difluorobenzyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 3,4-bis(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.014 g (6 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.17-8.21 (m, 1 H), 7.71 (s, 1 H), 7.07-7.39 (m, 4 H), 4.59 (s, 2 H), 3.55-3.68 (m, 8 H), 1.49 (s, 9 H); MS (ESI+) for C₂₃ H₂₅ F₂ N₃ O₄ S₂ *m/z* 510 (M+H)⁺. HPLC 64 %, R_T 2.02min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

INTERMEDIATE 79

***tert*-Butyl 4-{2-[(3,5-dimethoxybenzyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 3,5-dimethoxybenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.02 g (10 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.14-8.18 (m, 1 H), 7.55 (s, 1 H), 6.40-6.45 (m, 1 H), 6.26-6.34 (m, 2 H), 4.39 (s, 2 H), 3.54-3.72 (m, 14 H), 1.50 (s, 9 H); MS (ESI+) for C₂₅ H₃₁ N₃ O₆ S₂ *m/z* 534 (M+H)⁺. HPLC 69 %, R_T 1.99min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

EXAMPLE 104

4-(Piperazinyl)-2-(3-methoxybenzyl-sulfonyl)-thienopyridine

A 1:1 mixture of lithium 4-chloro-thienopyridine-2-sulfinate (0.176 g, 0.734 mmol) and 2-methoxybenzylbromide (0.295 g, 1.47 mmol) in DMF (5 mL) was heated at 100 °C for 2h. To the mixture was added Boc-piperazine (546 mg, 2.94 mmol) and the reaction was heated at 110 °C for 1.5h. The solvent was removed and the crude product was purified by preparative HPLC to obtain 17.4 mg of 4-(4-t-butyl-oxy-carbonyl-piperazinyl)-2-(3-methoxybenzyl-sulfonyl)-thienopyridine. The boc-protected product was dissolved in 2 mL of MeOH and 4 mL of HCl/ether was added to obtain 21.9 mg of 4-(piperazinyl)-2-(3-methoxybenzyl-sulfonyl)-thienopyridine. ¹H NMR (CD₃OD/D₂O 1:1) δ 6.42-6.38 (m, 1H), 7.51-7.48 (m, 1H), 7.39-7.35 (m, 1H), 6.92-6.85 (m, 1H), 6.64-6.59 (m, 1H), 6.48-6.39 (m, 2H), 3.64-3.58 (m, 4H), 3.19-3.13 (m, 4H), 2.96 (s, 3H), 2.92 (s, 2H); MS (ESI) 404 (M + H)⁺; Purity (HPLC, column YMC) 94%.

INTERMEDIATE 80

***tert*-Butyl 4-[2-(benzylsulfonyl)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.00 g (7 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.14 (d, *J*=5.5 Hz 1 H), 7.27-7.40 (m, 5 H), 7.15-7.21 (m, 2 H), 4.45 (s, 2 H), 3.50-3.56 (m, 4 H), 3.40-3.45 (m, 4 H), 1.49 (s, 9 H); MS (ESI⁺) for C₂₃ H₂₇ N₃ O₄ S₂ *m/z* 474 (M+H)⁺. HPLC 77 %, R_T 3.93min (ACE3 C8 50x4mm, 5-50 % acetonitrile in 3 min).

EXAMPLE 105

2-(Benzylsulfonyl)-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

tert-Butyl 4-[2-(benzylsulfonyl)thieno[3,2-c]pyridin-4-yl]piperazine-1-carboxylate (0.01 g, 0.02 mmol) was treated as described in Method R to give the desired product as a white solid. Yield 0.009 g, (100 %). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 8.98 (s, 1 H), 8.13-8.20 (d, *J*=8 Hz 1 H), 8.00 (s, 1 H), 7.64-7.71 (m, 1 H), 7.18-7.35 (m, 5 H), 4.93 (s, 2

H), 3.60-3.70 (m, 4 H), 3.22-3.34 (m, 4 H); MS (ESI+) for C₁₈H₁₉N₃O₂S₂ . Cl H *m/z* 374 (M+H)⁺. HPLC 90%, R_T 2.91min (ACE3 C8 50x4.6mm, 5-50% acetonitrile in 3 min).

5 INTERMEDIATE 81

***tert*-Butyl-4-(2-{[4-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 4-(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then
10 reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.02 g (16 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*=6 Hz 1 H), 7.53-7.61 (d, *J*= 9 Hz 2 H), 7.49 (s, 1 H), 7.26-7.36 (m, 4 H), 4.51 (s, 2 H), 3.49-3.60 (m, 4 H), 3.36-3.49 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄H₂₆F₃N₃O₄S₂ *m/z* 542 (M+H)⁺. HPLC 71 %, R_T 4.07min (ACE3 C8 50x4mm, 5-50 % acetonitrile in 3 min).

15

EXAMPLE 106

4-Piperazin-1-yl-2-{[4-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridine hydrochloride

tert-Butyl 4-(2-{[4-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-*c*]pyridin-4-yl)piperazine-
20 1-carboxylate (0.02 g, 0.03 mmol) was treated as described in Method R to give the desired product as a white solid. Yield 0.014 g (100 %) White solid. ¹H NMR (300 MHz, DMSO-*d*₆) δ 9.25 (s, 1 H), 8.12-8.22 (m, 2 H), 7.66-7.77 (m, 4 H), 7.41-7.52 (m, 2 H), 5.12 (s, 2 H), 3.22-3.35 (m, 4 H); MS (ESI+) for C₁₉H₁₈F₃N₃O₂S₂ . Cl H *m/z* 442 (M+H)⁺. HPLC 90 %, R_T 3.53min (ACE3 C8 50x4.6mm, 5-50 % acetonitrile in 3 min).

25

INTERMEDIATE 82

***tert*-Butyl-4-{2-[(3-bromobenzyl)sulfonyl]thieno[3,2-*c*]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-*c*]pyridine-2-sulfinate (0.44 mmol) was treated with 3-
30 bromobenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.023 g (10 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*=6 Hz, 1H),

7.50-7.55 (m, 2 H), 7.32-7.40 (m, 2 H), 7.10-7.24 (m, 3 H), 4.44 (s, 2 H), 3.61-3.73 (m, 8 H), 1.50 (s, 9 H); MS (ESI+) for C₂₃H₂₆BrN₃O₄S₂ *m/z* 554 (M+H)⁺. HPLC 77 %, R_T 4.07min (ACE3 C8 50x4.6mm, 5-50 % acetonitrile in 3 min).

5 **EXAMPLE 107**

2-[(3-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

tert-Butyl 4-{2-[(3-bromobenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate (0.023 g, 0.04 mmol) was treated as described in Method R to give the desired product as a white solid. Yield 0.013 g (67 %) White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.19 (s, 1 H), 8.18 (d, *J*= 6 Hz, 1 H), 8.05 (s, 1 H), 7.70 (d, *J*= 6 Hz, 1 H), 7.53-7.58 (m, 1 H), 7.43-7.45 (m, 1 H), 7.19-7.32 (m, 2 H), 4.98 (s, 2 H), 3.24-3.35 (m, 4 H); MS (ESI+) for C₁₈H₁₈BrN₃O₂S₂ · Cl H *m/z* 452 (M+H)⁺. HPLC 90 %, R_T 3.30min (ACE3 C8 50x4.6mm, 5-50 % acetonitrile in 3 min).

15 **INTERMEDIATE 83**

***tert*-Butyl 4-{2-[(3,4-difluorobenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with 3,4-bis(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.014 g (6 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.17-8.21 (m, 1 H), 7.71 (s, 1 H), 7.07-7.39 (m, 4 H), 4.59 (s, 2 H), 3.55-3.68 (m, 8 H), 1.49 (s, 9 H); MS (ESI+) for C₂₃H₂₅F₂N₃O₄S₂ *m/z* 510 (M+H)⁺. HPLC 64 %, R_T 2.02 min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

25

EXAMPLE 108

2-[(2,3-Difluorobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The BOC group was removed from *tert*-butyl 4-{2-[(3,4-difluorobenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate using Method R. Yield 0.068 g (100 %). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.34 (s, 1 H), 8.22 (s, 1 H), 8.18 (d, *J*=5.5 Hz, 1 H), 7.70 (d, *J*=5.5 Hz, 1 H), 7.26-7.35 (m, 1 H), 7.15-7.22 (m, 1 H), 7.05-7.14 (m, 1 H), 5.08 (s, 2 H), 3.34-3.42 (m, 4 H), 3.25-3.34 (m, 4 H);

MS (ESI+) for C₁₈H₁₇F₂N₃O₂S₂. Cl H *m/z* 410 (M+H)⁺. HPLC 90 %, R_T 1.07min (YMC ODS AQ, 33x3mm, 20-50 % acetonitrile in 1.5 min).

EXAMPLE 109

5 2-[(4-Bromobenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.42 mmol) was treated with 4-bromobenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. The BOC protecting group was removed using Method R. Yield 0.024 g (12 % over three steps).

10 White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 8.99 (s, 1 H), 8.18 (d, *J*= 5.5 Hz, 1 H), 8.02 (s, 1 H), 7.69 (d, *J*= 5.5 Hz, 1 H), 7.53 (d, *J*= 8.5 Hz, 2 H), 7.17 (d, *J*= 8.5 Hz, 2H), 4.95 (s, 2 H), 3.62-3.68 (m, 4 H), 3.27-3.32 (m, 4 H); MS (ESI+) for C₁₈H₁₈BrN₃O₂S₂. Cl H *m/z* 454 (M+H)⁺. HPLC 90 %, R_T 1.24min (YMC ODS AQ, 33x3mm, 20-50 % acetonitrile in 1.5 min).

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INTERMEDIATE 84

tert-Butyl-4-(2-{[2,5-bis(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with 2,5-

20 bis(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.01 g (4 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (d, *J*= 5.8 Hz, 1 H), 8.00 (s, 1 H), 7.74-7.85 (m, 3 H), 4.76 (s, 2 H), 3.56-3.64 (m, 4 H), 3.47-3.56 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₅H₂₅F₆N₃O₄S₂ *m/z* 610 (M+H)⁺. HPLC 73 %, R_T 2.36min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

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EXAMPLE 110

2-{[2,5-Bis(trifluoromethyl)benzyl]sulfonyl}-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

30 The BOC group was removed from *tert*-butyl 4-(2-{[2,5-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate using Method R. Yield 0.024 g (100 %). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.30 (s, 1 H), 8.25 (s, 1

H), 8.19 (d, $J=5.5$ Hz, 1 H), 8.00-8.07 (m, 2 H), 7.85 (s, 1 H), 7.69 (d, $J=5.5$ Hz, 1 H), 5.22 (s, 2 H), 3.24-3.33 (m, 4 H); MS (ESI+) for C₂₀H₁₇F₆N₃O₂S₂ . Cl H m/z 510 (M+H)⁺. HPLC 90 %, R_T 1.08min (YMC ODS AQ, 33x3mm, 30-60 % acetonitrile in 1.5 min).

5

INTERMEDIATE 85

***tert*-Butyl 4-{2-[(4-methylbenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with 4-methylbenzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.005 g (3 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.15 (d, $J=6$ Hz 1 H), 7.40 (s, 1 H), 7.00-7.16 (m, 4 H), 4.42 (s, 2 H), 3.46-3.60 (m, 4 H), 3.37-3.46 (m, 4 H), 2.34 (s, 3 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄H₂₉N₃O₄S₂ m/z 488 (M+H)⁺. HPLC 69 %
15 %, R_T 2.06min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

EXAMPLE 111

2-[(4-Methylbenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

The BOC group was removed from *tert*-butyl 4-{2-[(4-methylbenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate using Method R. Yield 0.05 g (75 %). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.18 (s, 1 H), 8.17 (d, $J=5.5$ Hz, 1 H), 8.01 (s, 1 H), 7.67 (d, $J=5.5$ Hz, 1 H), 7.38 (s, 1 H), 7.19 (s, 1 H), 7.11 (s, 1 H), 7.00 (s, 1 H), 4.86 (s, 2 H); MS (ESI+) for C₁₉H₂₁N₃O₂S₂ . Cl H m/z 388 (M+H)⁺. HPLC 90 %, R_T 1.65 min (ACE3 C8 50x3.0mm, 10-97 % acetonitrile in 3 min).

25

INTERMEDIATE 86

***tert*-Butyl 4-(2-{[5-chloro-2-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-c]pyridin-4-yl)piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with 5-chloro-2-(trifluoromethyl)benzylbromide (0.59 mmol) as described in Method P above and then reacted further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.019 g (7.5 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.12-8.14 (m, 1
30

H), 7.80-7.88 (m, 2 H), 7.47-7.66 (m, 2 H), 4.71 (s, 2 H), 3.74-3.83 (m, 4 H), 3.63-3.72 (m, 4 H), 1.49 (s, 9 H); MS (ESI+) for C₂₄H₂₅ClF₃N₃O₄S₂ *m/z* 576 (M+H)⁺. HPLC 74 %, R_T 2.30min (YMC ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

5 EXAMPLE 112

2-{{[5-Chloro-2-(trifluoromethyl)benzyl]sulfonyl}-4-piperazin-1-yl}thieno[3,2-c]pyridine hydrochloride

The BOC group was removed from *tert*-butyl 4-(2-{{[5-chloro-2-(trifluoromethyl)benzyl]sulfonyl}thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate using
10 Method r. Yield 0.012 g (92 %). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.05 (s, 1 H), 8.18-8.23 (m, 2 H), 7.78-7.83 (m, 1 H), 7.72-7.76 (m, 1 H), 7.69 (d, *J*=5.5 Hz, 1 H), 7.62-7.65 (m, 1 H), 5.07 (s, 2 H), 3.65-3.72 (m, 4 H), 7.25-7.34 (m, 4 H); MS (ESI+) for C₁₉H₁₇ClF₃N₃O₂S₂ . Cl H *m/z* 476 (M+H)⁺. HPLC 90 %, R_T 1.65 min (ACE3 C8 50x3.0mm, 10-97 % acetonitrile in 3 min).

15

INTERMEDIATE 87

***tert*-Butyl 4-{2-[(3,5-dimethoxybenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Lithium 4-chlorothieno[3,2-c]pyridine-2-sulfinate (0.44 mmol) was treated with 3,5-dimethoxybenzylbromide (0.59 mmol) as described in Method P above and then reacted
20 further with *tert*-butyl-piperazine-1-carboxylate as described in Method Q. Yield 0.02 g (10 % over two steps). Beige solid. ¹H NMR (300 MHz, CDCl₃) δ 8.14-8.18 (m, 1 H), 7.55 (s, 1 H), 6.40-6.45 (m, 1 H), 6.26-6.34 (m, 2 H), 4.39 (s, 2 H), 3.54-3.72 (m, 14 H), 1.50 (s, 9 H); MS (ESI+) for C₂₅H₃₁N₃O₆S₂ *m/z* 534 (M+H)⁺. HPLC 69 %, R_T 1.99min (YMC
25 ODS AQ, 33x3mm, 10-90 % acetonitrile in 3 min).

EXAMPLE 113

2-[(3,5-Dimethoxybenzyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-c]pyridine hydrochloride

30 The BOC group was removed from *tert*-butyl 4-{2-[(3,5-dimethoxybenzyl)sulfonyl]thieno[3,2-c]pyridin-4-yl}piperazine-1-carboxylate using Method R. Yield 0.01g (62%). White solid. ¹H NMR (300 MHz, DMSO-d₆) δ 9.09 (s, 1

H), 8.18 (d, J = 6.7 Hz, 1 H), 8.02 (s, 1 H), 7.69 (d, J = 6.7 Hz, 1H), 6.45-6.48 (m, 1 H), 6.35-6.38 (m, 2 H), 4.84 (s, 2H), 3.61-3.67 (m, 4H), 3.58 (s, 6H), 3.24-3.33 (m, 4H).MS (ESI+) for $C_{20}H_{22}N_3O_4S_2$ m/z 434 ($M+H$)⁺. HPLC 90 %, R_T 1.60 min (ACE3 C8 50x3.0mm, 10-97 % acetonitrile in 3 min).

5

EXAMPLE 114

2-[(2-Naphthylmethyl)sulfonyl]-4-piperazin-1-ylthieno[3,2-*c*]pyridine hydrochloride

2-(Bromomethyl)naphthalene was used according to Method P-R to give 12.4 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm (obscured by CH₃OH, 4H) 3.70-3.79 (m, 4 H) 4.95 (s, 2 H) 7.36-7.58 (m, 3 H) 7.70-7.91 (m, 6 H) 8.02 (d, J =6.60 Hz, 1 H). MS ($M+1$) 424.

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EXAMPLE 115

4-Piperazin-1-yl-2-[[4-(1,2,3-thiadiazol-4-yl)benzyl]sulfonyl]thieno[3,2-*c*]pyridine hydrochloride

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4-[4-(Bromomethyl)phenyl]-1,2,3-thiadiazole was used according to Method P-R to give 4.8 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm 3.41-3.50 (m, 4 H) 3.54 (s, 2 H) 3.89-3.98 (m, 4 H) 7.45 (d, J =8.44 Hz, 2 H) 7.75 (d, J =6.33 Hz, 1 H) 7.96-8.13 (m, 4 H) 9.31 (s, 1 H). MS ($M+1$) 458.

20

EXAMPLE 116

1-(4-Pyrrolidin-1-ylphenyl)-2-[(4-piperazine-1-ylthieno[3,2-*c*]pyridin-2-yl) sulfonyl] ethanone hydrochloride

2-Bromo-1-(4-pyrrolidin-1-ylphenyl)ethanone was used according to Method P-R to give 19.6 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-*d*₄) δ ppm 2.02-2.12 (m, 4 H) 2.69 (s, 1 H) 3.37 (t, J =6.73 Hz, 4 H) 3.54 (s, 1 H) 3.56-3.64 (m, 4 H) 4.12-4.22 (m, 4 H) 6.55 (d, J =8.97 Hz, 2 H) 7.78-7.90 (m, 3 H) 8.03 (d, J =6.86 Hz, 1 H) 8.41 (s, 1 H). MS ($M+1$) 471.

25

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EXAMPLE 117

1-[4-(Diethylamino)phenyl]-2-[(4-piperazine-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] ethanone hydrochloride

2-Bromo-1-[4-(diethylamino)phenyl]ethanone was used according to Method P-
5 R to give 9.0 mg of the desired product. ¹H NMR (500 MHz, CH₃OH-d₄) δ ppm 1.16 (t, J=7.06 Hz, 6 H) 3.49-3.66 (m, 10 H) 4.14-4.27 (m, 4 H) 7.13 (br.s, 2 H) 7.85 (d, J=6.59 Hz, 1 H) 7.98 (d, J=8.48 Hz, 2 H) 8.03 (d, J=6.59 Hz, 1 H) 8.47 (s, 1 H). MS (M+1) 473.

EXAMPLE 118

10 **1-(4-Bromophenyl)-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] ethanone**

2-Bromo-1-(4-bromophenyl)ethanone was used according to method A to give 3.4 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 3.55 (s, 2 H) 3.56-3.67 (m, 4 H) 4.08-4.26 (m, 4 H) 7.68 (d, J=8.44 Hz, 2 H) 7.79-7.98 (m, 3 H) 8.06 (d, J=6.60 Hz, 1 H) 8.45 (s, 1 H). MS (M+1) 481.

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EXAMPLE 119

1-(3-Methoxyphenyl)-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl) sulfonyl] ethanone

2-bromo-1-(3-methoxyphenyl)ethanone was used according to method A to give 1.0 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 3.54 (s, 2 H) 3.55-6.62 (m, J=10.03 Hz, 4 H) 3.82 (s, 3 H) 4.06-4.18 (m, 4 H) 7.20 (dd, J=8.05, 2.24 Hz, 1 H) 7.34-
20 7.49 (m, 2 H) 7.57 (d, J=7.39 Hz, 1 H) 7.84 (d, J=6.60 Hz, 1 H) 8.06 (d, J=6.60 Hz, 1 H) 8.41 (s, 1 H). MS (M+1) 432.

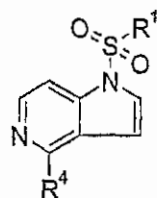
EXAMPLE 120

25 **1-Phenyl-2-[(4-piperazin-1-ylthieno[3,2-c]pyridin-2-yl)sulfonyl]ethanone**

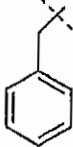
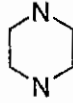
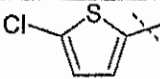
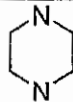
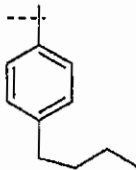
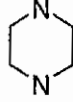
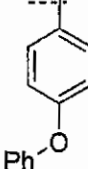
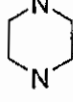
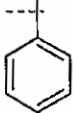
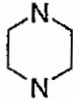
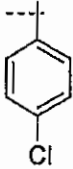
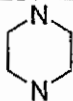
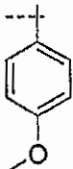
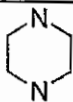
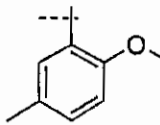
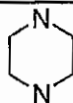
2-Bromo-1-phenylethanone was used according to method A to give 1.2 mg of the desired product. ¹H NMR (270 MHz, CH₃OH-d₄) δ ppm 3.55 (s, 2 H) 3.57-3.66 (m, 4 H) 4.10-4.24 (m, 4 H) 7.46-4.57 (m, 2 H) 7.66 (t, J=7.39 Hz, 1 H) 7.86 (d, J=6.60 Hz, 1 H) 8.02 (dd, J=14.12, 6.99 Hz, 3 H) 8.46 (s, 1 H). MS (M+1) 402.

30

Table 6

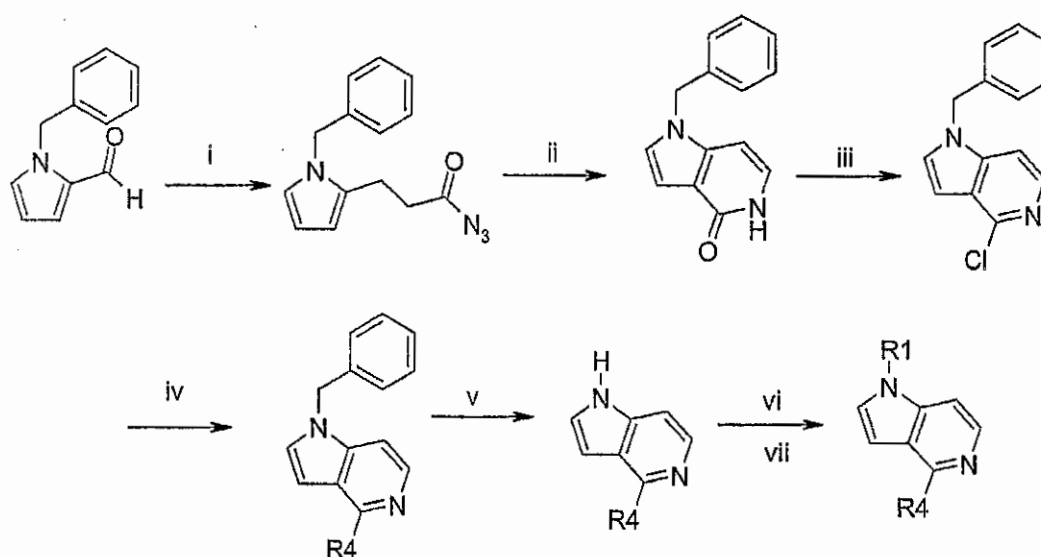


EXAMPLE		R ¹	R ⁴
121	4-Piperazin-1-yl-1-(toluene-4-sulfonyl)-1H-pyrrolo[3,2-c]pyridine hydrochloride		
122	1-(3-Chloro-2-methyl-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
123	1-(3,4-Dimethoxy-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
124	4-(4-Piperazin-1-yl-pyrrolo[3,2-c]pyridine-1-sulfonyl)-benzonitrile hydrochloride		
125	1-(4,5-Dichloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
126	1-(2-Chloro-4-fluoro-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		

127	1-Phenylmethanesulfonyl-4-piperazin-1-yl-1H-pyrrolo [3,2-c]pyridine hydrochloride		
128	1-(5-Chloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
129	1-(4-Butyl-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo(3,2-c)pyridine hydrochloride		
130	1-(4-Phenoxy-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo(3,2-c)pyridine hydrochloride		
131	1-(Phenylsulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
132	1-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
133	1-[(4-Methoxyphenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		
134	1-[(2-Methoxy-5-methylphenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride		

135	4-Piperazin-1-yl-1-{[2-(trifluoromethyl)phenyl]sulfonyl}-1H-pyrrolo[3,2-c]pyridine hydrochloride		
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Scheme 8



Legend to Scheme 8: i) Ethylchloroformate, TEA, acetone, NaN_3 ; ii) Bu_3N , DCM and diphenylether; iii) POCl_3 , NaOH ; iv) BOC protected amines (R^4), K_2CO_3 , DMSO; v) NH_3 gas, Na , NH_4Cl , THF; vi) Sulphonyl chlorides (R^1), NaH , THF; vii) HCl /diethyl ether, methanol.

10 INTERMEDIATE 88

(2E)-3-(1-Benzyl-1H-pyrrol-2-yl)acryloyl azide

To a mixture of 1-benzyl-1H-pyrrole-2-carbaldehyde (28.4g, 0.125mol) and TEA (13.5 mL, 0.187 mol) in acetone (300 mL) was added ethylchloroformate (17.9 mL, 0.87 mol) dropwise. The reaction was stirred for 1.5 h after which NaN_3 (13 g, 0.200 mol) in H_2O (100 mL) was added. After 2h, the reaction was diluted with water and left overnight. The acetone was removed and the product was filtered off to afford 21.4 g of a light brown solid. This compound was taken to the next step.

INTERMEDIATE 89

1-Benzyl-1,5-dihydro-pyrrolo[3,2-c]pyridin-4-one was prepared by the literature procedure according to C. Ducrocq; E. Bisangi; J-M, Lhoste; J. Mispelter; *Tetrahedron*, Vol 32, pp 773-780, (1976).

To a stirred solution of n-tributylamine (30 mL) in diphenyl ether (150 mL) heated to 195 °C was slowly added during 30 minutes a solution of the acyl azide dissolved in DCM (150 mL). The reaction mixture was stirred at 195 °C for 1 hour and then cooled to room temperature. Pentane (1.0 L) and ether (1.0 L) was added to the reaction mixture and the precipitate was collected by filtration. The crude solid was triturated with ether to give 6.89 g (81%) of the pure product. Purity HPLC >95%; MS (ESI) m/z 225 (m+H); ¹H NMR (DMSO-*d*₆, 25 °C, 270.16) δ 10.84 (br s, 1 H), 7.43-7.14 (m, 6 H), 7.00 (d, J = 7.12 Hz, 1 H), 6.57-6.49 (m, 2 H), 5.83 (s, 2 H).

INTERMEDIATE 90

1-Benzyl-4-chloro-1H-indole

POCl₃ (3.11 mL, 33.4 mmol) was added to 1-benzyl-1,5-dihydro-4H-pyrrolo[3,2-c]pyridin-4-one (3.75 g, 16.7 mmol) and the reaction was stirred at 120°C for 2h. NaOH (1M) was added and the mixture was extracted with DCM three times. The organic layers were dried (MgSO₄), filtered and the solvent was removed. Flash chromatography (DCM/Heptane/MeOH 4:15:1) gave 1.17 g (29 %) of product. The product was taken to the next step.

INTERMEDIATE 91

tert-Butyl 4-(1-benzyl-1H-pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate

A mixture of 1-benzyl-4-chloro-1H-indole (1.17 g, 4.82 mmol), K₂CO₃ (2.0 g, mmol) and Boc-piperazine (1.79 g, 9.64 mmol) in DMSO (75 mL) was stirred at 120 °C for 48 h. Additional of Boc-piperazine (4 equiv.) was added and the reaction was run for another 48 h. The reaction was diluted with ethyl acetate (200 mL) and the mixture was washed with several portions of water. Flash chromatography (DCM/MeOH/Heptane 4:1:15) gave 0.51 g of starting material and 0.38 g of product. ¹HNMR (CD₃OD) δ 7.87-7.85 (m, 1H), 7.25-7.24 (m, 3H), 7.04-6.98 (m, 3H), 6.73-6.71 (m, 1H), 6.53-6.52 (m, 1H), 5.19 (s, 2H), 3.63-3.59 (m, 8H), 1.47 (s, 9H); MS (ESI) 393 (M + H)⁺; Purity (HPLC, column ACE) 95%

INTERMEDIATE 92

***tert*-Butyl 4-(1H-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate**

tert-Butyl 4-(1-benzyl-1H-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate (383 mg, 0.488 mmol) was dissolved in THF (6 mL) and liquid ammonia (10 mL) in a 30 mL vial. Na (67 mg, 2.93 mmol) was added in portions and the reaction turned violet. After 30 min NH₄Cl (sat) was added and the reaction was let to room temperature. The THF was removed and the residue was extracted with DCM. Recrystallization (DCM/Heptane) gave 112 mg of a white solid. ¹HNMR (CD₃OD) δ 8.66 (s, 1H), 7.89 (d, 1H, *J* = 5.80 Hz), 7.13-7.11 (m, 1H), 6.89-6.86 (m, 1H), 6.57-6.56 (m, 1H), 3.67-3.60 (m, 8H), 1.48 (s, 9H); MS (ESI) 303 (M + H)⁺; Purity (HPLC, column ACE) 95%.

Method S for sulphonylation: *tert*-butyl 4-(1H-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate (total 1.391 mmol, 1 equiv.) dissolved in THF (14 mL) and dispense to 10 mL vials with screwcap. A suspension of NaH (0.1488 mmol, 1.5 equiv.) in THF (15 mL) was dispense evenly to the vials containing the solution of *tert*-butyl 4-(1H-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate and stirred for approximately for 15 min. Different sulfonylchlorides were dissolved in THF (2 mL) each and added drop-wise to the reaction mixtures. The reactions were quenched with MeOH (100 μL) and PS-Trisamine (3 equiv.) was added to each vial and shake for 2 hours. The mixtures were filtered and the filtrates were concentrate under vacuum. The products that were not pure enough (Purity < 90%) were purified by preparative chromatography using acetonitrile-water gradients containing 0.1% trifluoroacetic acid. After HPLC analysis fractions that were ≥ 90% pure were collected and concentrated.

25

Method T BOC deprotection; The Boc-protected compound was dissolved in MeOH (2 mL) and HCl/ether (2 mL) was added. After 45 min the solvent was removed.

INTERMEDIATE 93

***tert*-Butyl-4-[1-(phenylsulfonyl)-1H-pyrrolo[3,2-c]pyridin-4-yl]piperazine-1-carboxylate**

Purification by recrystallization gave 16 mg (56 %) after Boc-deprotection.

- 5 ¹HNMR (CDCl₃) δ 8.03-8.01 (m, 1H), 7.89-7.86 (m, 2H), 7.57-7.39 (m, 5H), 6.67-6.64 (m, 1H), 3.55-3.52 (m, 8H), 1.47 (s, 9H); MS (ESI) 443 (M + H)⁺; Purity (HPLC, column ACE) 95%.

INTERMEDIATE 94

- 10 ***tert*-Butyl-4-{1-[(4-chlorophenyl)sulfonyl]-1H-pyrrolo[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Purification by preparative HPLC gave 4 mg (11 %) after Boc-deprotection.

¹HNMR (CDCl₃) δ 8.03-7.51 (m, 7H), 6.89-6.87 (m, 1H), 3.91-3.66 (m, 8H), 1.47 (s, 9H); MS (ESI) 377 (M + H)⁺; Purity (HPLC, column ACE) 95%.

15

INTERMEDIATE 95

***tert*-Butyl-4-{1-[(4-methoxyphenyl)sulfonyl]-1H-pyrrolo[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Purification by recrystallization (MeOH/Ether) gave 21 mg (67 %) after boc-deprotection.

- 20 ¹HNMR (CDCl₃) δ 8.02-8.00 (m, 1H), 7.84-7.80 (m, 2H), 7.48-7.46 (m, 1H), 7.41-7.38 (m, 1H), 6.92-6.86 (m, 2H), 6.64-6.62 (m, 1H), 3.79 (s, 3H), 3.57-3.52 (m, 8H), 1.48 (s, 9H); MS (ESI) 473 (M + H)⁺; Purity (HPLC, column ACE) 95%.

INTERMEDIATE 96

- 25 ***tert*-Butyl 4-(1-{[2-(trifluoromethyl)phenyl]sulfonyl}-1H-pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate**

Purification by preparative HPLC gave 8.6 mg (25 %) after boc-deprotection. ¹HNMR (CDCl₃) δ 8.14-8.11 (m, 1H), 8.01-7.94 (m, 2H), 7.89-7.72 (m, 3H), 7.37-7.34 (m, 1H), 6.89-6.88 (m, 1H), 3.93-3.89 (m, 4H), 3.71-3.67 (m, 4H), 1.47 (s, 9H); MS (ESI) 511 (M + H)⁺; Purity (HPLC, column ACE) 95%.

30

INTERMEDIATE 97

***tert*-Butyl 4-{1-[(2-methoxy-5-methylphenyl)sulfonyl]-1H-pyrrolo[3,2-c]pyridin-4-yl}piperazine-1-carboxylate**

Purification by preparative HPLC gave 10.3 mg (32 %) after boc-deprotection. ¹HNMR (CDCl₃) δ 7.95-7.92 (m, 2H), 7.74-7.72 (m, 1H), 7.44-7.40 (m, 2H), 6.85-6.77 (m, 2H), 3.92-3.88 (m, 4H), 3.70 (s, 3H), 3.69-3.66 (m, 4H), 2.39 (s, 3H), 1.47 (s, 9H); MS (ESI) 487 (M + H)⁺; Purity (HPLC, column ACE) 95%.

EXAMPLE 121

4-Piperazin-1-yl-1-(toluene-4-sulfonyl)-1H-pyrrolo[3,2-c]pyridine hydrochloride
p-Toulenesulfonyl chloride (24.6 mg) was added to *tert*-butyl 4-(1H-pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate the title compound (4.3 mg). LC/MS R_T: 1.374 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 91%. MS: 357 (M+1) ¹HNMR (CD₃OD) δ ppm 2.39 (s, 3 H) 3.48 (m, 4 H) 4.06 (m, 4 H) 7.22 (d, *J*=3.71 Hz, 1 H) 7.43 (d, *J*=8.16 Hz, 2 H) 7.95 (m, 5 H).

EXAMPLE 122

1-(3-Chloro-2-methyl-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

3-Chloro-2-methylbenzenesulfonyl chloride (29.0 mg) was added to *tert*-butyl 4-(1H-pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate the title compound (6.3 mg). LC/MS R_T: 1.563 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 96%. MS: 392 (M+1).

EXAMPLE 123

1-(3,4-Dimethoxy-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

3,4-Dimethoxybenzenesulfonyl chloride (30.5 mg) was added to *tert*-butyl 4-(1H-pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate the title compound (8.5 mg). LC/MS R_T: 1.284 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 92%. MS: 404 (M+1) ¹HNMR (CD₃OD) δ ppm 3.50 (m, *J*=4.21 Hz, 2 H) 3.85 (d, *J*=3.22 Hz, 4 H) 4.10

(m, $J=3.96$ Hz, 2 H) 7.11 (d, $J=8.66$ Hz, 1 H) 7.23 (d, $J=3.46$ Hz, 1 H) 7.48 (d, $J=1.73$ Hz, 1 H) 7.74 (dd, $J=8.54, 1.86$ Hz, 1 H) 7.92 (s, 2 H) 8.07 (d, $J=3.46$ Hz, 1 H).

EXAMPLE 124

5 **4-(4-Piperazin-1-yl-pyrrolo[3,2-c]pyridine-1-sulfonyl)-benzonitrile hydrochloride**
4-Cyanobenzenesulfonyl chloride (26.0mg) was added to *tert*-butyl 4-(1*H*-pyrrolo[3,2-
c]pyridin-4-yl)piperazine-1-carboxylate the title compound (9.1 mg). LC/MS R_T : 1.150
(System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 93%. MS: 369 (M+1) 1H NMR
(CD₃OD) δ ppm 3.50 (m, 4 H) 4.08 (m, 4 H) 7.29 (d, $J=3.71$ Hz, 2 H) 7.98 (m, 4 H) 8.29
10 (d, $J=8.66$ Hz, 2 H).

EXAMPLE 125

1-(4,5-Dichloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

15 4,5-Dichloro-thiophene-2-sulfonyl chloride (32.4 mg) was added to *tert*-butyl 4-(1*H*-
pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate the title compound (0.3 mg). LC/MS
 R_T : 1.119 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 92%. MS: 418
(M+1).

20 EXAMPLE 126

1-(2-Chloro-4-fluoro-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

2-Chloro-4-fluorobenzenesulfonyl chloride (29.5 mg) was added to *tert*-butyl 4-(1*H*-
pyrrolo[3,2-c]pyridin-4-yl)piperazine-1-carboxylate the title compound (2.4 mg). LC/MS
25 R_T : 1.361 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 90%. MS: 396
(M+1) 1H NMR (CD₃OD) δ ppm 3.51 (m, 4 H) 4.08 (m, 4 H) 7.23 (dd, $J=3.96, 0.49$ Hz, 1
H) 7.47 (m, 1 H) 7.55 (dd, $J=8.41, 2.47$ Hz, 2 H) 7.62 (d, $J=6.93$ Hz, 1 H) 7.91 (d, $J=7.18$
Hz, 1 H) 8.06 (d, $J=3.96$ Hz, 1 H).

30

EXAMPLE 127

1-Phenylmethanesulfonyl-4-piperazin-1-yl-1H-pyrrolo [3,2-*c*]pyridine hydrochloride

Phenyl-methanesulfonyl chloride (24.6 mg) was added to *tert*-butyl 4-(1*H*-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate the title compound (0.2 mg). LC/MS R_T : 1.007 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 90%. MS: 357 ($M+1$).

EXAMPLE 128

1-(5-Chloro-thiophene-2-sulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-*c*]pyridine hydrochloride

5-Chlorothiophene-2-sulfonyl chloride (28.0 mg) was added to *tert*-butyl 4-(1*H*-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate the title compound (7.2 mg). LC/MS R_T : 1.381 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 97%. MS: 483 ($M+1$).

EXAMPLE 129

1-(4-Butyl-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo(3,2-*c*)pyridine hydrochloride

4-N-Butylbenzenesulfonylchloride (30.0 mg) was added to *tert*-butyl 4-(1*H*-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate the title compound (11.9 mg). LC/MS R_T : 1.904 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 95%. MS: 400 ($M+1$) ^1H NMR (CD_3OD) δ ppm 0.90 (t, $J=7.18$ Hz, 3 H) 1.31 (m, 2 H) 1.55 (m, 2 H) 2.67 (m, 2 H) 3.50 (m, 4 H) 4.09 (m, $J=3.96$ Hz, 4 H) 7.25 (d, $J=3.71$ Hz, 2 H) 7.44 (d, $J=8.16$ Hz, 2 H) 7.91 (m, 2 H) 8.02 (m, 2 H).

EXAMPLE 130

1-(4-Phenoxy-benzenesulfonyl)-4-piperazin-1-yl-1H-pyrrolo(3,2-*c*)pyridine hydrochloride

(4-Phenoxy)benzene)sulfonyl chloride (34.7 mg) was added to *tert*-butyl 4-(1*H*-pyrrolo[3,2-*c*]pyridin-4-yl)piperazine-1-carboxylate the title compound (12.8 mg). LC/MS R_T : 1.839 (System 10 till 40% MeCN over 1.5 min, ACE C8), Purity. 95%. MS: 436 ($M+1$) ^1H NMR (CD_3OD) δ ppm 3.50 (m, $J=3.96$ Hz, 4 H) 4.09 (m, $J=4.45$ Hz, 4 H) 7.05 (dd, $J=8.16, 6.43$ Hz, 2 H) 7.26 (m, 2 H) 7.44 (t, $J=7.79$ Hz, 2 H) 7.90 (m, 3 H) 8.01 (d, $J=3.71$ Hz, 2 H) 8.07 (d, $J=8.91$ Hz, 2 H).

EXAMPLE 131

1-(Phenylsulfonyl)-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

Purification by recrystallization gave 16 mg (56 %) after Boc-deprotection. MS (ESI)

5 343.1 (M + H)⁺; Purity (HPLC, column ACE) 94%.

EXAMPLE 132

1-[(4-Chlorophenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

10 Purification by preparative HPLC gave 4 mg (11 %) after Boc-deprotection. MS (ESI) 377 (M + H)⁺; Purity (HPLC, column ACE) 96%.

EXAMPLE 133

1-[(4-Methoxyphenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride

15

Purification by recrystallization (MeOH/Ether) gave 21 mg (67 %) after Boc-deprotection. MS (ESI) 373 (M + H)⁺; Purity (HPLC, column ACE) 92%

EXAMPLE 134

20 **1-[(2-Methoxy-5-methylphenyl)sulfonyl]-4-piperazin-1-yl-1H-pyrrolo[3,2-c]pyridine hydrochloride**

Purification by preparative HPLC gave 10.3 mg (32 %) after Boc-deprotection. MS (ESI) 387 (M + H)⁺; Purity (HPLC, column ACE) 95%.

25 EXAMPLE 135

4-Piperazin-1-yl-1-[2-(trifluoromethyl)phenyl]sulfonyl-1H-pyrrolo[3,2-c]pyridine hydrochloride

Purification by preparative HPLC gave 8.6 mg (25 %) after Boc-deprotection. MS (ESI) 411 (M + H)⁺; Purity (HPLC, column ACE) 94%.

30

BIOLOGICAL TESTS

The ability of a compound according to the invention to bind a 5-HT₆ receptor, and to be pharmaceutically useful, can be determined using *in vivo* and *in vitro* assays known in the art.

(a) 5-HT₆ binding Assay

Binding affinity experiment for the 5-HT₆ receptor are performed in HEK293 cells transfected with 5-HT₆ receptor using (3H)-LSD as labeled ligand according to the general method as described by Boess F.G et al. Neuropharmacology vol. 36(4/5) 713-720, 1997.

Materials

15 Cell culture

The HEK-293 cell line transfected with the 5-HT₆ receptor was cultured in Dulbeccos Modified Eagles Medium containing 5 % dialyzed foetal bovine serum, (Gibco BRL 10106-169), 0.5 mM sodium pyruvate and 400 µg/ml Geneticin (G-418) (Gibco BRL10131-019). The cells were passaged 1:10, twice a week.

20

Chemicals

The radioligand [³H] LSD 60-240 Ci/mmol, obtained from Amersham Pharmacia Biotech, (Buckinghamshire, England) was in ethanol and stored at -20°C. The unlabelled ligands, representing different selectivity profiles, are presented in Table 1. The compounds were dissolved in 100% DMSO and diluted with binding buffer.

25

Disposable

Compounds were diluted in Costar 96 well V-bottom polypropylene plates (Corning Inc. Costar, NY, USA). Samples were incubated in Packard Optiplate (Packard Instruments B.V., Groningen, The Netherlands). The total amount of added radioligand was measured in Packard 24-well Barex plates (Packard Instruments B.V., Groningen, The Netherlands)

30

in the presence of Microscint™ 20 scintillation fluid (Packard Bioscience, Meriden, CT, USA).

Buffer

- 5 The binding buffer consisted of 20 mM HEPES, 150 mM NaCl, 10 mM MgCl₂, and 1 mM, EDTA, pH 7.4.

Methods

Membrane preparation

- 10 Cells were grown to approximately 90% confluence on 24.5 x 24.5 NUNC culture dishes. The medium was aspirated, and after rinsing with ice-cold PBS, the cells were scraped off using 25 ml Tris buffer (50 mM Tris-HCl, 1 mM EDTA, 1 mM EGTA, pH 7.4) and a window scraper. The cells were then broken with a Polytron homogeniser, and remaining particulate matter was removed by low-speed centrifugation, 1000x g for 5 min. Finally, 15 the membranes were collected by high-speed centrifugation (20 000x g), suspended in binding buffer, and frozen in aliquots at -70°C.

Radioligand binding

- Frozen cell membranes were thawed, immediately rehomogenized with a Polytron 20 homogenizer, and coupled to SPA wheat germ agglutinin beads (Amersham Life Sciences, Cardiff, England) for 30 min under continuous shaking of the tubes. After coupling, the beads were centrifuged for 10 minutes at 1000 g, and subsequently suspended in 20 ml of binding buffer per 96-well plate. The binding reaction was then initiated by adding radioligand and test compounds to the bead-membrane suspension. Following incubation 25 at room temperature, the assay plates were subjected to scintillation counting.
- The original SPA method was followed except for that membranes were prepared from HEK293 cells expressing the human 5-HT₆ receptor instead of from HeLa cells (Dinh DM, Zaworski PG, Gill GS, Schlachter SK, Lawson CF, Smith MW. Validation of human 5-HT₆ receptors expressed in HeLa cell membranes: saturation binding studies, 30 pharmacological profiles of standard CNS agents and SPA development. The Upjohn Company Technical Report 7295-95-064 1995;27 December). The specific binding of

[³H]LSD was saturable, while the non-specific binding increased linearly with the concentration of added radioligand. [³H] LSD bound with high affinity to 5-HT₆ receptors. The K_d value was estimated to 2.6 ± 0.2 nM based on four separate experiments.

- 5 The total binding at 3 nM of [³H] LSD, the radioligand concentration used in the competition experiments, was typically 6000 dpm, and the specific binding more than 70%. 5-HT caused a concentration dependent inhibition of [³H] LSD binding with an overall average K_i value of 236 nM when tested against two different membrane preparations. The inter assay variability over three experiments showed a CV of 10% with an average K_i values of 173 nM (SD 30) and a Hill coefficient of 0.94 (SD 0.09). The intra assay variation was 3% (n=4). K_i values for a limited set of reference compounds with reported binding affinities at 5-HT₆ receptor are presented in Table 7. All unlabelled ligands displaced the specific binding of [³H] LSD in a concentration-dependent manner, albeit at different potencies. The rank order of potency for the compounds was methiothepin (2 nM) 10 >mianserin (190 nM) ≈5-HT (236 nM) >methysergide (482 nM) >mesulergide (1970 nM). 15

Protein determination

- Protein concentrations were determined with BioRad Protein Assay (Bradford MM. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. Anal Biochem 1976;72:248-54). Bovine serum albumin was used as standard. 20

Scintillation counting

- The radioactivity was determined in a Packard TopCount™ scintillation counter (Packard Instruments, Meriden, CT, USA) at a counting efficiency of approximately 20 %. The counting efficiency was determined in separate sets of experiments. 25

Saturation experiments

- At least 6 concentrations in duplicates of radioligand (0.1-20 nM of [³H] LSD) were used in saturation experiments. The specific binding was calculated as the difference between total binding and non-specific binding, which was determined as the binding of radioligand 30

in the presence of 5 μ M lisuride. $B_{\max}$ and the dissociation constant, K_d , were determined from the non-linear regression analysis using equation 1. L_u is the unbound concentration of radioligand, and y is the amount bound.

$$y = \frac{B_{\max} \cdot Lu}{Lu + Kd} \quad (\text{equation 1})$$

5

Competition experiments

Total- and non-specific binding of radioligand was defined in eight replicates of each. Samples containing test compound were run in duplicate at 11 concentrations. Incubations were carried out at room temperature for 3 hours. The IC_{50} value, i.e. the concentration of
10 test compound that inhibited 50% of the specific binding of radioligand, was determined with non linear regression analysis and the K_i value was calculated using the method of [Cheng Y.C. Biochem. Pharmacol. 22, 3099-3108, 1973S] equation 2.

$$Ki = \frac{IC_{50}}{1 + \frac{L}{Kd}} \quad (\text{equation 2})$$

L = concentration of radioligand

15 K_d = Affinity of radioligand

(b) 5-HT₆ Intrinsic Activity Assay

Antagonists to the 5-HT₆ receptor were characterized by measuring inhibition of 5-HT
20 induced increase in cAMP in HEK 293 cells expressing the human 5-HT₆ receptor (see Boess et al. (1997) Neuropharmacology 36: 713-720). Briefly, HEK293/5-HT₆ cells were seeded in polylysine coated 96-well plates at a density of 25,000 / well and grown in DMEM (Dulbecco's Modified Eagle Medium) (without phenol-red) containing 5% dialyzed Foetal Bovine Serum for 48 h at 37°C in a 5% CO₂ incubator. The medium was
25 then aspirated and replaced by 0.1 ml assay medium (Hanks Balance Salt Solution containing 20 mM HEPES, 1.5 mM isobutylmethylxanthine and 1 mg/ml bovine serum albumin). After addition of test substances, 50 μ l dissolved in assay medium, the cells were incubated for 10 min at 37°C in a 5% CO₂ incubator. The medium was again aspirated and the cAMP content was determined using a radioactive cAMP kit (Amersham Pharmacia

Biotech, BIOTRAK RPA559). The potency of antagonists was quantified by determining the concentration that caused 50% inhibition of 5-HT (at [5-HT]= 8 times EC₅₀) evoked increase in cAMP, using the formula $IC_{50,corr}=IC_{50}/(1+[5HT]/EC_{50})$.

- 5 The compounds in accordance with the invention have a selective affinity to 5-HT₆ receptors with K_i and IC_{50,corr} values between 0.5 nM and 5 μM or display a % inhibition of [³H] LSD ≥ 20 % at 50 nM and are antagonists, agonist or partial agonist at 5-HT₆. The compounds show good selectivity over 5-HT_{1a}, 5-HT_{2a}, 5-HT_{2a}, 5-HT_{2b}, 5-HT_{2c}.

10 (c) *In vivo* assay of reduction of food intake

For a review on serotonin and food intake, see Blundell, J.E. and Halford, J.C.G. (1998) Serotonin and Appetite Regulation. Implications for the Pharmacological Treatment of Obesity. CNS Drugs 9:473-495.

15

Obese (ob/ob) mouse is selected as the primary animal model for screening as this mutant mouse consumes high amounts of food resulting in a high signal to noise ratio. To further substantiate and compare efficacy data, the effect of the compounds on food consumption is also studied in wild type (C57BL/6J) mice. The amount of food consumed during 15

- 20 hours of infusion of compounds is recorded.

Male mice (obese C57BL/6JBom-Lep^{ob} and lean wild-type C57B1/6JBom; Bomholtsgaard, Denmark) 8-9 weeks with an average body weight of 50 g (obese) and 25 g (lean) are used in all the studies. The animals are housed singly in cages at 23±1°C, 40-25 60 % humidity and have free access to water and standard laboratory chow. The 12/12-h light/dark cycle is set to lights off at 5 p.m. The animals are conditioned for at least one week before start of study.

The test compounds are dissolved in solvents suitable for each specific compound such as 30 cyclodextrin, cyclodextrin/methane sulfonic acid, polyethylene glycol/methane sulfonic

acid, saline. Fresh solutions are made for each study. Doses of 30, 50 and 100 mg kg⁻¹day⁻¹ are used. The purity of the test compounds is of analytical grade.

The animals are weighed at the start of the study and randomized based on body weight.

- 5 Alzet osmotic minipumps (Model 2001D; infusion rate 8 µl/h) are used and loaded essentially as recommended by the Alzet technical information manual (Alza Scientific Products, 1997; Theeuwes, F. and Yam, S.I. *Ann. Biomed. Eng.* 4(4). 343-353, 1976). Continuous subcutaneous infusion with 24 hours duration is used. The minipumps are either filled with different concentrations of test compounds dissolved in vehicle or with
- 10 only vehicle solution and maintained in vehicle pre-warmed to 37°C (approx. 1h). The minipumps are implanted subcutaneously in the neck/back region under short acting anesthesia (metofane/enflurane). This surgical procedure lasts approximately 5 min. It takes about 3 h to reach steady state delivery of the compound.
- 15 The weight of the food pellets are measured at 5 p.m. and at 8 p. m. for two days before (baseline) and one day after the implantation of the osmotic minipumps. The weigh-in is performed with a computer assisted Mettler Toledo PR 5002 balance. Occasional spillage is corrected for. At the end of the study the animals are killed by neck dislocation and trunk blood sampled for later analysis of plasma drug concentrations.

20

- The plasma sample proteins are precipitated with methanol, centrifuged and the supernatant is transferred to HPLC vials and injected into the liquid chromatography /mass spectrometric system. The mass spectrometer is set for electrospray positive ion mode and Multiple Reaction Monitoring. A linear regression analysis of the standards forced through
- 25 the origin is used to calculate the concentrations of the unknown samples.

- Food consumption for 15 hours is measured for the three consecutive days and the percentage of basal level values is derived for each animal from the day before and after treatment. The values are expressed as mean ± SD and ± SEM from eight animals per dose
- 30 group. Statistical evaluation is performed by Kruskal-Wallis one-way ANOVA using the percent basal values. If statistical significance is reached at the level of p<0.05, Mann-

Whitney U-test for statistical comparison between control and treatment groups is performed.

The compounds according to the invention show an effect in the range of 5-200 mg/kg.

5

Table 7. Biological data

In vitro binding at the human 5-HT₆ receptor

EXAMPLE	K _i (nM) human 5-HT ₆
1	10
11	6.5
20	10.5
40	7.5
43	4.5
68	13
85	32
131	5

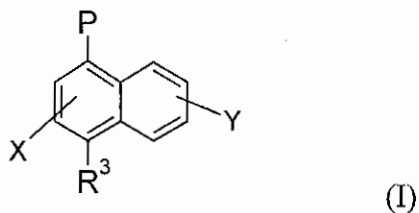
10 **In vivo efficacy data**

EXAMPLE	% FI reduction*	Css, u (uM)
1	12	0.44
11	47.1	0.02
40	44	0.2

*Effect on Food Intake reduction In Ob/ob mice Single administration 50 mg/kg/d measured at steady state

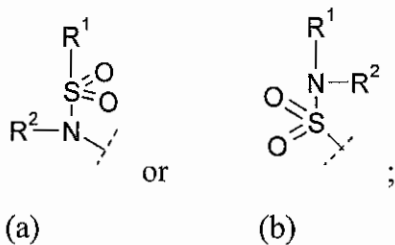
CLAIMS

1. A compound of the formula (I):



or a pharmaceutically acceptable salt thereof, wherein:

P is any one of formula (a) or (b)



R¹ is

(a) C₁₋₆ alkyl,

(b) C₁₋₆ alkoxyalkyl,

15 (c) straight-chained or branched C₁₋₆ hydroxyalkyl,

(d) straight-chained or branched C₁₋₆ alkylhalides,

(e) aryl carbonylmethyl,

(f) C₃₋₇ cycloalkyl, which is optionally partially unsaturated,

(g) C₃₋₇ cycloalkyl-C₁₋₆ alkyl, wherein the cyclic ring is optionally partially unsaturated, or

20 (h) a group Ar;

wherein Ar is

(a) phenyl,

(b) 1-naphthyl,

25 (c) 2-naphthyl,

- (d) aryl-C₁₋₆ alkyl,
- (e) cinnamyl,
- (f) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated, mono- or bi-cyclic heterocyclic ring, each containing 1 to 4 heteroatoms, selected from oxygen, sulfur, and nitrogen,
- (g) a bicyclic ring system comprising at least one heterocyclic ring according to (f) and a group Ar,

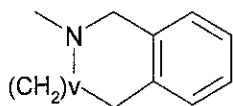
wherein the group Ar is substituted in one or more positions with

- (a) H, X or Y, or
- (b) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated, heterocyclic ring each containing 1 to 4 heteroatoms selected from oxygen, nitrogen or sulfur;

R² is

- (a) H,
- (b) C₁₋₆ alkyl,
- (c) C₂₋₆ alkoxyalkyl,
- (d) straight or branched C₁₋₆ hydroxyalkyl, or
- (e) straight or branched C₁₋₆ alkylhalides;
- (f) a group Ar,

or R¹ and R² are linked to form a group -CH₂CH₂OCH₂CH₂- or

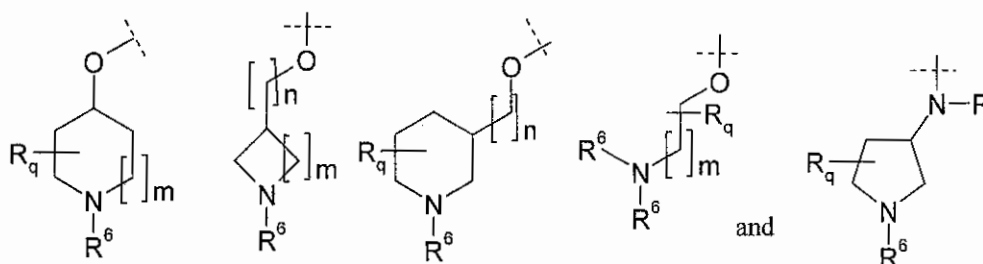


wherein v is 0-2,

- X and Y are independently
- (a) H,
- (b) halogen,
- (c) C₁₋₆ alkyl,
- (d) CF₃,
- (e) hydroxy,
- (f) C₁₋₆ alkoxy,

- (g) C₂₋₆ alkenyl,
 - (h) phenyl,
 - (i) phenoxy,
 - (j) benzyloxy,
 - 5 (k) benzoyl,
 - (l) -OCF₃,
 - (m) -CN,
 - (n) straight or branched C₁₋₆ hydroxyalkyl,
 - (o) straight or branched C₁₋₆ alkylhalides,
 - 10 (p) -NH₂,
 - (q) -NHR⁴,
 - (r) -NR⁴R⁵,
 - (s) -NO₂,
 - (t) -CONR⁴R⁵,
 - 15 (u) -NHSO₂R⁴,
 - (v) -NR⁴COR⁵,
 - (x) -SO₂NR⁴R⁵,
 - (z) -C(=O)R⁴,
 - (aa) -CO₂R⁴, or
 - 20 (ab) -S(O)_nR⁴, wherein n is 0, 1, 2 or 3,
 - (ac) -S-(C₁₋₆) alkyl, or
 - (ad) -SCF₃; and
- R⁴ and R⁵ are independently
- 25 (a) H,
 - (b) C₁₋₆ alkyl,
 - (c) C₃₋₇ cycloalkyl, or
 - (d) Ar, as defined above for R¹;
- alternatively, R⁴ and R⁵ are linked to form a group -CH₂OCH₂-, -CH₂CH₂OCH₂CH₂- or
- 30 (CH₂)₃₋₅;

R³ is a group selected from any one of



wherein R³ is optionally substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or (C₁₋₆) alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

q = 1, 2, 3, 4, 5 or 6,

m = 1 or 2, and

n = 0, 1 or 2;

- 10 R⁶ is independently
- (a) H,
 - (b) linear or branched C₁₋₆ alkyl,
 - (c) benzyl,
 - (d) -CH₂-CH₂-OH, or
 - 15 (e) -CH₂-CH₂-O-C₁₋₆ alkyl;

provided that

20 when R¹ = Ar is partially saturated bi-cyclic heterocyclic ring containing a N atom, the N atom in Ar cannot be attached to the S atom in P.

2. The compound according to claim 1, wherein

R¹ is

- (a) C₁₋₆ alkyl, or
- 25 (e) a group Ar;

Ar is

- (a) phenyl,
- (b) 1-naphthyl,

(c) 2-naphthyl, or

(f) a 5 to 7-membered, optionally aromatic, partially saturated or completely saturated, heterocyclic ring containing 1 to 4 heteroatoms, selected from oxygen, nitrogen and sulfur,

wherein the group Ar is substituted in one or more positions with

- 5 (a) H,
(b) halogen,
(c) C₁₋₆ alkyl,
(d) -CF₃,
(f) C₁₋₆ alkoxy,
10 (g) C₂₋₆ alkenyl,
(i) -OCF₃,
(m) straight or branched C₁₋₆ hydroxyalkyl,
(n) phenyloxy,
(o) benzyloxy,
15 (v) -NR⁴COR⁵,
(x) -SO₂NR⁴R⁵,
(z) -C(=O)R⁴,
(ab) -S(O)_nR⁴, wherein n is 0, 1, 2 or 3;
(ac) -S-(C₁₋₆) alkyl, or
20 (ad) -SCF₃;

R² is

- (a) H, or
(b) C₁₋₆ alkyl;

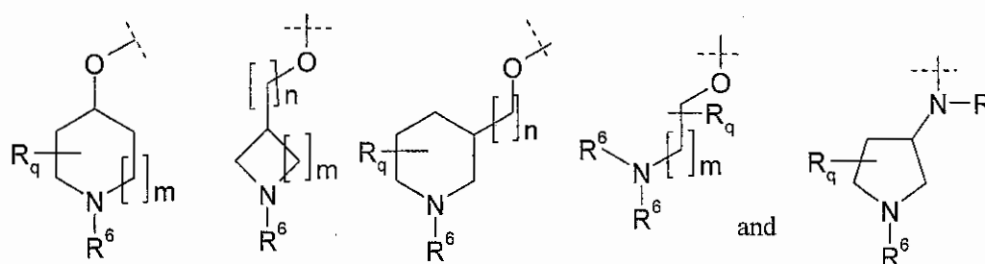
25

or R¹ and R² are linked to form a group -CH₂CH₂OCH₂CH₂-;

X and Y are H;

30 R⁴ and R⁵ are each independently H or C₁₋₃ alkyl; and

R³ is selected from any one of



wherein R^3 can be substituted on each carbon atom that allows the substitution with R_q groups, wherein R_q is independently H, or C_{1-6} alkyl, and wherein two R_q groups can be present on the same carbon atom simultaneously, wherein

$q = 1$ or 2 ,

$m = 1$ or 2 ,

$n = 0$, and

R^6 is independently

(a) H,

(b) C_{1-6} alkyl, in particular methyl,

(d) $-CH_2-CH_2-OH$, or

(e) $-CH_2-CH_2-OCH_3$.

3. A compound according to any one of claims 1 to 2 wherein R^6 is H or methyl.

4. The compound according to any one of claims 1 to 3, wherein R^2 is H.

5. A compound according to claim 1, which is the compound

4-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

4-Methoxy-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

5-Chloro-N-[4-(pyrrolidin-3-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride;

4-Chloro-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

4-Methoxy-N-[4-(piperidin-3-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

5-Fluoro-2-methyl-N-[4-(piperidin-4-yloxy)-1-naphthyl]benzenesulfonamide hydrochloride;

5-Chloro-N-[4-(piperidin-4-yloxy)-1-naphthyl]thiophene-2-sulfonamide hydrochloride;

4-Chloro-N-{4-[(3S)-pyrrolidin-3-yloxy]-1-naphthyl}benzenesulfonamide hydrochloride;

or

4-Chloro-N-{4-[(3R)-pyrrolidin-3-yloxy]-1-naphthyl} benzenesulfonamide hydrochloride.

6. A process for the preparation of a compound according to any one of claims 1 to 5, said method comprising the steps of:

- 5 (a) Mitsunobu reaction of 4-nitro-1-naphthol with boc-protected 3-hydroxypyrrolidine or 4-hydroxypiperidine;
- (b) reduction of the nitro group in the nitronaphthalene obtained in step (a) to form an aminonaphthalene derivative; and
- 10 (c) synthesis of a sulfonamide by reacting the aminonaphthalene obtained in step (b) with a suitable sulfonyl chloride.

7. A compound according to any one of claims 1 to 5 for use in therapy.

8. A compound according to any one of claims 1 to 5, for use in the treatment or
- 15 prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, to achieve reduction of body weight and of body weight gain.

9. A compound according to any one of claims 1 to 5, for use in the treatment or
- 20 prophylaxis of type II diabetes.

10. A pharmaceutical formulation comprising a compound according to any one of claims 1 to 5 as an active ingredient, in combination with a pharmaceutically acceptable diluent or carrier.

- 25 11. A pharmaceutical formulation comprising a compound according to any one of claims 1 to 5, as an active ingredient, for use in the treatment or prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, to achieve reduction of body weight and of body weight gain.

- 30 12. A pharmaceutical formulation comprising a compound according to any one of claims 1 to 5, for use in the treatment or prophylaxis of type II diabetes.

13. Use of a compound according to any one of claims 1 to 5, for the manufacture of a medicament for use in the treatment or prophylaxis of a 5-HT₆ receptor related disorder, such as obesity, to achieve reduction of body weight and of body weight gain.
- 5 14. Use of a compound according to any one of claims 1 to 5, for the manufacture of a medicament for use in the treatment or prophylaxis of type II diabetes.