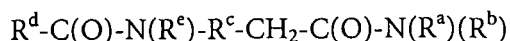


Novel heteroarylacetamides

The invention is concerned with novel heteroarylacetamides of formula (I),



(I)

5 wherein

R^a is hydrogen or C_{1-6} alkyl;

R^b is $R^{b1}-R^{b2}$, wherein

10 R^{b1} is aryl or heteroaryl, said aryl and heteroaryl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkyl and halogen, and

15 R^{b2} is aryl, heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} alkoxy, halogen, cyano, nitro, amino, mono- or di- C_{1-6} alkyl substituted amino, hydroxy, hydroxy C_{1-6} alkyl, aminocarbonyl, mono- or di- C_{1-6} alkyl substituted aminocarbonyl, halo C_{1-6} alkyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylsulfinyl, C_{1-6} alkylthio, amino C_{1-6} alkyl, mono- or di- C_{1-6} alkyl substituted amino C_{1-6} alkyl, aminosulfonyl and mono- or di- C_{1-6} alkyl substituted amino sulfonyl, and one or two carbon atoms of said aryl, heteroaryl and heterocyclyl being optionally replaced with a carbonyl group; or

20 R^a and R^b , together with the nitrogen atom to which they are attached, form heterocyclyl-A- R^{b3} , wherein said heterocyclyl is optionally substituted by halogen or C_{1-6} alkyl, and

A is a bond, -O- or C₁₋₆ alkylene wherein one -CH₂- is optionally replaced with a carbonyl group, and/or another -CH₂- is optionally replaced with -NR^f-, and

5 R^{b3} is amino optionally mono- or di-substituted by a substituent independently selected from the group consisting of C₁₋₆ alkyl, C₂₋₆ alkenyl and C₂₋₆ alkynyl, or

10 R^{b3} is aryl, heteroaryl, C₃₋₇ cycloalkyl or heterocyclyl, said aryl, heteroaryl, C₃₋₇ cycloalkyl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₁₋₆ alkoxy, halogen, cyano, nitro, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, amino C₁₋₆ alkyl, mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl, aminosulfonyl and mono- or di-C₁₋₆ alkyl substituted amino sulfonyl, and one or two carbon atoms of said aryl, heteroaryl, C₃₋₇ cycloalkyl and heterocyclyl being optionally replaced with a carbonyl group;

20 R^c is heteroaryl optionally substituted by one or more substituents independently selected from the group consisting of halogen and C₁₋₆ alkyl, and one or two carbon atoms of said heteroaryl being optionally replaced with a carbonyl group;

25 R^d is aryl, heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl optionally being substituted by one or more substituents independently selected from the group consisting of halogen, C₁₋₆ alkyl and C₁₋₆ alkoxy, and the aryl may be fused to a heterocyclyl ring;

R^e is hydrogen or C₁₋₆ alkyl;

R^f is hydrogen or C₁₋₆ alkyl;

and prodrugs and pharmaceutically acceptable salts thereof.

Further, the invention is concerned with a process for the manufacture of the above compounds; pharmaceutical preparations which contain such compounds as well as the use of these compounds for the production of pharmaceutical preparations.

5 The compounds of formula (I) are active compounds and inhibit the coagulation factor Xa. These compounds consequently influence blood coagulation. They therefore inhibit the formation of thrombi and can be used for the treatment and/or prevention of thrombotic disorders, such as amongst others, arterial and venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease (PAOD), unstable angina pectoris, myocardial infarction, coronary artery disease, 10 pulmonary embolism, stroke (cerebral thrombosis) due to atrial fibrillation, inflammation and arteriosclerosis. They have potentially benefit in the treatment of acute vessel closure associated with thrombolytic therapy and restenosis, e.g. after transluminal coronary angioplasty (PTCA) or bypass grafting of the coronary or peripheral arteries and in the maintenance of vascular access patency in long term hemodialysis patients. F.Xa inhibitors of this invention may form part of a 15 combination therapy with an anticoagulant with a different mode of action or with a platelet aggregation inhibitor or with a thrombolytic agent. Furthermore, these compounds have an effect on tumour cells and prevent metastases. They can therefore also be used as antitumour agents.

20 Other inhibitors of factor Xa had previously been suggested for the inhibition of the formation of thrombi and for the treatment of related diseases. However, there is still a need for novel factor Xa inhibitors which exhibit improved pharmacological properties, e.g. an improved selectivity towards thrombin.

25 The present invention provides novel compounds of formula (I) which are factor Xa inhibitors. The compounds of the present invention unexpectedly inhibit coagulation factor Xa and also exhibit improved pharmacological properties compared to other compounds already known in the art.

30 Unless otherwise indicated, the following definitions are set forth to illustrate and define the meaning and scope of the various terms used to describe the invention herein.

The term "halogen" or "halo" means fluorine, chlorine, bromine and iodine, with fluorine, chlorine and bromine being preferred, and fluorine and chlorine being more preferred.

The term "C₁₋₆ alkyl", alone or in combination with other groups, means a branched or straight-chain monovalent alkyl radical, having one to six carbon atoms. This term is further exemplified by such radicals as methyl, ethyl, n-propyl, isopropyl, n-butyl, s-butyl, t-butyl. C₁₋₄ alkyl is more preferred.

- 5 The term "C₁₋₆ alkylene" means a linear saturated divalent hydrocarbon radical of one to six carbon atoms or a branched saturated divalent hydrocarbon radical of three to six carbon atoms, e.g., methylene, ethylene, 2,2-dimethylethylene, propylene, 2-methylpropylene, butylene, pentylene.

- 10 The term "halo C₁₋₆ alkyl" means C₁₋₆ alkyl substituted by one or more same or different halogen atoms independently selected from the group consisting of chlorine, fluorine and bromine. CF₃ is preferred.

The term "C₃₋₇ cycloalkyl", alone or in combination with other groups, means a saturated monovalent cyclic hydrocarbon radical of three to seven ring carbons, e.g., cyclopropyl, cyclobutyl, cyclohexyl.

- 15 The term "C₁₋₆ alkoxy", alone or in combination with other groups, means the group R'-O-, wherein R' is a C₁₋₆ alkyl.

The term "C₂₋₆ alkenyl", alone or in combination with other groups, means a straight-chain or branched hydrocarbon residue comprising an olefinic bond, having two to six carbon atoms, such as e.g. ethenyl, 2-propenyl.

- 20 The term "C₂₋₆ alkynyl", alone or in combination with other groups, means a straight-chain or branched hydrocarbon residue comprising a triple bond, having two to six carbon atoms, such as e.g. ethynyl, propynyl.

The term "aryl", alone or in combination with other groups, means a phenyl or a naphthyl group, preferably a phenyl group.

- 25 The term "heterocyclyl", alone or combination with other groups, means non-aromatic mono- or bi-cyclic radicals of three to eight ring atoms in which one or two ring atoms are heteroatoms selected from N, O, or S(O)_n (where n is an integer from 0 to 2), the remaining ring atoms being C.

- 30 The term "heteroaryl", alone or combination with other groups, means a monocyclic or bicyclic radical of 5 to 12 ring atoms having at least one aromatic

ring containing one, two, or three ring heteroatoms selected from N, O, and S, the remaining ring atoms being C, with the understanding that the attachment point of the heteroaryl radical will be on an aromatic ring.

The term "mono-C₁₋₆ alkyl substituted amino" and "di-C₁₋₆ alkyl substituted amino", alone or combination with other groups, mean -NHR and -NRR' respectively, in which R and R' are the same or different C₁₋₆ alkyl.

Preferred radicals for the chemical groups whose definitions are given above are those specifically exemplified in Examples.

Compounds of formula (I) can form pharmaceutically acceptable acid addition salts. Examples of such pharmaceutically acceptable salts are salts of compounds of formula (I) with physiologically compatible mineral acids, such as hydrochloric acid, sulphuric acid, sulphurous acid or phosphoric acid; or with organic acids, such as methanesulphonic acid, p-toluenesulphonic acid, acetic acid, lactic acid, trifluoroacetic acid, citric acid, fumaric acid, maleic acid, tartaric acid, succinic acid or salicylic acid. The term "pharmaceutically acceptable salts" refers to such salts. Compounds of formula (I) in which a COOH group is present can further form salts with bases. Examples of such salts are alkaline, earth-alkaline and ammonium salts such as e.g. Na-, K-, Ca- and Trimethylammoniumsalt. The term "pharmaceutically acceptable salts" also refers to such salts. Acid addition salts as described above are preferred.

"Optional" or "optionally" means that the subsequently described event or circumstance may but need not occur, and that the description includes instances where the event or circumstance occurs and instances in which it does not. For example, "aryl group optionally substituted with an alkyl group" means that the alkyl may but need not be present, and the description includes situations where the aryl group is substituted with an alkyl group and situations where the aryl group is not substituted with the alkyl group.

"Pharmaceutically acceptable excipient" means an excipient that is useful in preparing a pharmaceutical composition that is generally safe, non-toxic and neither biologically nor otherwise undesirable, and includes excipient that is acceptable for veterinary use as well as human pharmaceutical use. A "pharmaceutically acceptable excipient" as used in the specification and claims includes both one and more than one such excipient.

Compounds that have the same molecular Formula but differ in the nature or sequence of bonding of their atoms or the arrangement of their atoms in space are termed "isomers." Isomers that differ in the arrangement of their atoms in space are termed "stereoisomers". Stereoisomers that are not mirror images of one another are termed "diastereomers" and those that are non-superimposable mirror images of each other are termed "enantiomers". When a compound has an asymmetric center, for example, if a carbon atom is bonded to four different groups, a pair of enantiomers is possible. An enantiomer can be characterized by the absolute configuration of its asymmetric center and is described by the R- and S-sequencing rules of Cahn, Ingold and Prelog, or by the manner in which the molecule rotates the plane of polarized light and designated as dextrorotatory or levorotatory (i.e., as (+) or (-)-isomers respectively). A chiral compound can exist as either individual enantiomer or as a mixture thereof. A mixture containing equal proportions of the enantiomers is called a "racemic mixture".

The compounds of formula (I) can possess one or more asymmetric centers. Unless indicated otherwise, the description or naming of a particular compound in the specification and claims is intended to include both individual enantiomers and mixtures, racemic or otherwise, thereof. The methods for the determination of stereochemistry and the separation of stereoisomers are well-known in the art (see discussion in Chapter 4 of "Advanced Organic Chemistry", 4th edition J. March, John Wiley and Sons, New York, 1992).

While the broadest definition of this invention is described before, certain compounds of Formula (I) are preferred.

i) A preferred compound of the invention is a compound of Formula (I) wherein R^a and R^b , together with the nitrogen atom to which they are attached, form heterocyclyl-A- R^{b3} , wherein said heterocyclyl is optionally substituted by halogen or C_{1-6} alkyl, and A and R^{b3} are as defined before.

The heterocyclyl of heterocyclyl-A- R^{b3} is preferably piperazinyl or piperidinyl, said piperazinyl and piperidinyl being optionally substituted by one or more substituents independently selected from the group consisting of halogen and C_{1-6} alkyl, especially non substituted piperazinyl or non substituted piperidinyl. Piperazin-1-yl or piperidin-1-yl, said piperazin-1-yl and piperidin-1-yl being bonded to -A- R^{b3} at 4-position is especially preferred.

A is preferably a bond or C₁₋₆ alkylene wherein one -CH₂- is optionally replaced with a carbonyl group, and/or another -CH₂- is optionally replaced with -NR^f-; in which R^f is hydrogen or C₁₋₆ alkyl. A is more preferably a bond, methylene, ethylene, -CH₂-C(O)-, -C(O)-CH₂- or -C(O)-, especially a bond or -CH₂-C(O)-.

5 R^{b3} is preferably heterocyclyl optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₁₋₆ alkoxy, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, and one or two carbon atoms of
10 said heterocyclyl being optionally replaced with a carbonyl group. Heterocyclyl for R^{b3} is preferably one having a nitrogen as a ring member atom, such as piperidinyl, pyrrolidinyl, morpholinyl, piperazinyl or thiazolidinyl, said heterocyclyl group being optionally substituted by one or more substituents, preferably one substituent independently selected from the group consisting of C₁₋₆ alkyl, C₁₋₆ alkoxy, amino,
15 mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, and one or two carbon atoms of said heterocyclyl group being optionally replaced with a carbonyl group.

Heterocyclyl for R^{b3} is more preferably pyrrolidinyl, piperidinyl or piperazinyl, said
20 heterocyclyl groups being unsubstituted or substituted by one C₁₋₆ alkyl. Especially non substituted pyrrolidin-1-yl or 1-methyl-piperidin-4-yl is preferred.

ii) Another preferred compound of the invention is a compound of Formula (I) wherein R^a is hydrogen or C₁₋₆ alkyl, and R^b is R^{b1}-R^{b2}, wherein R^{b1} and R^{b2} are as defined before.

25 R^a is preferably hydrogen.

R^{b1} is preferably phenyl or pyridyl, said phenyl and pyridyl being optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl and halogen, preferably optionally substituted by one halogen atom. R^{b1} is more preferably phenyl optionally substituted by one or more
30 same or different halogen atoms, preferably one halogen atom, especially fluorine.

R^{b2} is preferably aryl, heteroaryl or heterocyclyl, more preferably heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl being optionally substituted by

one or more substituents, preferably one substituent independently selected from the group consisting of C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, amino C₁₋₆ alkyl, mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl, aminosulfonyl, mono- or di-C₁₋₆ alkyl substituted amino sulfonyl, and one or two carbon atoms of said aryl, heteroaryl and heterocyclyl being optionally replaced with a carbonyl group.

A preferred aryl for R^{b2} is phenyl optionally substituted by one substituent selected from the group consisting of C₁₋₆ alkylsulfonyl, aminosulfonyl and mono- or di-C₁₋₆ alkyl substituted amino sulfonyl.

10 R^{b2} is more preferably heteroaryl or heterocyclyl having a ring member nitrogen atom bonded to R^{b1}, said heteroaryl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, amino C₁₋₆ alkyl, mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl, aminosulfonyl and mono- or di-C₁₋₆ alkyl substituted amino sulfonyl, and one or two carbon atoms of said heteroaryl and
15 heterocyclyl being optionally replaced with a carbonyl group.

A preferred heteroaryl for R^{b2} is a mono cyclic heteroaryl having one or two nitrogen atoms as a ring member such as pyridyl, imidazolyl, pyrrolyl, pyrazolyl, pyrazinyl, pyrimidinyl, pyridazinyl, preferably pyridyl or imidazolyl, especially
20 pyridyl. Preferably said heteroaryl is attached to R^{b1} via the nitrogen atom, and unsubstituted or substituted by amino C₁₋₆ alkyl or mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl. Moreover, preferably one carbon atom of said heteroaryl is replaced with a carbonyl group. 2-oxo-2H-pyridin-1-yl is especially preferred.

25 A preferred heterocyclyl for R^{b2} is a mono cyclic heterocyclyl having one nitrogen atom and, in addition to it, oxygen and/or sulphur atom as a ring member such as morpholinyl, 1,1-dioxo-thiazianyl, 1,1-dioxo-isothiazolidinyl, 3-oxomorpholinyl. Preferably said heterocyclyl is attached to R^{b1} via the nitrogen atom, and unsubstituted. In addition, preferably one carbon atom of the heterocyclyl for R^{b2}
30 is replaced with a carbonyl group at the position adjacent to the ring member atom attached to R^{b1}, or the heterocyclyl for R^{b2} has -SO₂- as a ring member at the position adjacent to the ring member atom attached to R^{b1}.

iii) Another preferred compound of the invention is a compound of Formula (I) wherein R^e is hydrogen.

iv) Another preferred compound of the invention is a compound of Formula (I) wherein R^c is mono cyclic heteroaryl having a nitrogen atom and/or a sulphur atom as a ring member atom such as thiazolyl, pyrazolyl, triazolyl, tetrazolyl, pyridonyl. Triazolyl is especially preferred.

v) Another preferred compound of the invention is a compound of Formula (I) wherein R^d is aryl, preferably phenyl, or heteroaryl, preferably thienyl, pyridyl or indolyl, especially thienyl, said aryl and heteroaryl being optionally substituted by one or more substituents, preferably one substituent, independently selected from the group consisting of halogen, C₁₋₆ alkyl and C₁₋₆ alkoxy.

A preferred aryl for R^d is phenyl substituted by one halogen atom such as fluorine, bromine, chlorine, preferably chlorine. 4-chlorophenyl is especially preferred.

A preferred heteroaryl for R^d is thienyl, pyridyl or indolyl, said heteroaryls being optionally substituted by one halogen atom such as fluorine, bromine, chlorine, preferably chlorine. 5-chloro-thiophen-2-yl is especially preferred.

Particularly preferred compounds of the present invention are:

[4-(2-[1,4']-Bipiperidiny-1'-yl-2-oxo-ethyl)-thiazol-2-yl]-4-chloro-benzamide,

N-{4-[2-(4-Benzyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-4-chloro-benzamide,

4-Chloro-N-{4-[2-(4-cyclohexylmethyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide,

4-Chloro-N-(4-{2-[4-(2-morpholin-4-yl-ethyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,

4-Chloro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,

4-Chloro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,

4-Chloro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,

4-Chloro-{4-[2-(4-cyclopentyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide,

- 4-Chloro-N-(4-{2-[4-(2-morpholin-4-yl-2-oxo-ethyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,
- 5 4-Chloro-N-{4-[2-(4-dimethylcarbamoylmethyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide,
- 10 4-Chloro-N-[4-(2-{4-[2-(4-methyl-piperazin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 15 4-Chloro-N-[4-(2-{4-[(1-methyl-piperidin-4-ylcarbamoyl)-methyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 20 4-Chloro-N-[4-(2-oxo-2-{4-[2-(2-oxo-pyrrolidin-1-yl)-acetyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide,
- 3 3-Fluoro-4-methoxy-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,
- 25 4-Chloro-N-[4-(2-{4-[2-(cyclohexylmethyl-amino)-acetyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 30 4-Methoxy-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,
- 5-Chloro-thiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 35 5-Chloro-thiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 2,3-Dihydro-benzofuran-5-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 40 4-Chloro-N-(4-{2-oxo-2-[4-(2-pyrrolidin-1-yl-acetyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,
- 45 5-Chloro-pyridine-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 4-Chloro-(RS)-[4-(2-{4-[2-(3-dimethylamino-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 50 4-Chloro-(RS)-[4-(2-{4-[2-(3-hydroxy-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 4-Chloro-[4-(2-{4-[2-((R)-2-hydroxymethyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 4-Chloro-[4-(2-{4-[2-((S)-2-hydroxymethyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,

- 4-Chloro-[4-(2-{4-[2-(2,2-dimethyl-thiazolidin-3-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 5 4-Chloro-N-(4-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 4-Chloro-N-(4-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 10 N-{4-[(2'-tert-Butylsulfamoyl-3-fluoro-biphenyl-4-ylcarbamoyl)-methyl]-thiazol-2-yl}-4-chloro-benzamide,
- (S)-1-[2-(4-{2-[2-(4-Chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidine-2-carboxylic acid dimethylamide,
- 15 4-Chloro-N-{4-[(3-fluoro-2'-sulfamoyl-biphenyl-4-ylcarbamoyl)-methyl]-thiazol-2-yl}-benzamide,
- 20 4-Chloro-N-(4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,
- Benzo[1,3]dioxole-5-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 25 5-Methyl-thiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 5-Bromo-thiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 30 4-Chloro-N-[4-(2-oxo-2-{4-[2-(2-oxo-oxazolidin-3-yl)-ethyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide,
- 35 4-Chloro-N-(4-{[5-(2-methanesulfonyl-phenyl)-pyridin-2-ylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- (S)-1-[2-(4-{2-[2-(4-Chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidine-2-carboxylic acid methylamide,
- 40 4-Chloro-[4-(2-{4-[2-(3-methanesulfonyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- N-{4-[2-(4-Benzoyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-4-chloro-benzamide,
- 45 4-Chloro-[4-(2-{4-[2-((1S,3R,5R)-3-hydroxy-8-aza-bicyclo[3.2.1]oct-8-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,
- 50 4-Chloro-[4-(2-{4-[2-((R)-3-ethoxy-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide,

- 1H-Indole-6-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide,
- 5 4-Chloro-3-fluoro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,
- 4-Chloro-(4-{2-oxo-2-[4-(2-oxo-2-thiazolidin-3-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,
- 10 [4-(2-{4-[2-(3-Amino-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-4-chloro-benzamide,
- 4-Chloro-[4-(2-oxo-2-{4-[2-oxo-2-((R)-2-trifluoromethyl-pyrrolidin-1-yl)-ethyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide,
- 15 4-Chloro-N-(4-{2-[4-(4,5-dihydro-thiazol-2-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,
- 5-Bromo-thiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide,
- 20 5-Chloro-thiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide,
- 25 5-Chloro-thiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide,
- 3-Fluoro-4-methoxy-N!-(4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,
- 30 4-Chloro-(4-{[4-(2-dimethylaminomethyl-imidazol-1-yl)-2-fluoro-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 4-Chloro-(4-{[2-fluoro-4-(3-oxo-morpholin-4-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 35 4-Chloro-(4-{[4-(1,1-dioxo-[1,2]thiazinan-2-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 4-Chloro-(4-{[4-(1,1-dioxo-isothiazolidin-2-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide,
- 40 5-Methyl-thiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide,
- 45 4-Chloro-(4-{2-[4-(4-methyl-piperazin-1-yl)-piperidin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide,
- 5-Chloro-thiophene-2-carboxylic acid (4-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-amide,
- 50 4-Chloro-N-(4-{2-oxo-2-[4-(pyridin-2-yloxy)-piperidin-1-yl]-ethyl}-thiazol-2-yl)-benzamide,

- 5-Chloro-thiophene-2-carboxylic acid (4-{2-[4-(4-methyl-piperazin-1-yl)-piperidin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide,
- 5-Chloro-thiophene-2-carboxylic acid (4-{[2-fluoro-4-(3-oxo-morpholin-4-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-amide,
- 4-Chloro-N-(1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-pyrazol-3-yl)-benzamide,
- 5-Chloro-thiophene-2-carboxylic acid (1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-pyrazol-3-yl)-amide,
- 5-Chloro-thiophene-2-carboxylic acid (1-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-1H-pyrazol-3-yl)-amide,
- 4-Chloro-N-(1-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-1H-pyrazol-3-yl)-benzamide,
- 5-Chloro-thiophene-2-carboxylic acid (1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-[1,2,4]triazol-3-yl)-amide,
- 5-Chloro-thiophene-2-carboxylic acid (1-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-1H-[1,2,4]triazol-3-yl)-amide,
- 5-Chloro-thiophene-2-carboxylic acid (2-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-2H-tetrazol-5-yl)-amide.

The compounds of the present invention can be prepared, for example, by the general synthetic procedures described below.

General Synthetic Procedures

Abbreviations

BOP: Benzotriazolyl-N-oxy-tris(dimethylamino)-phosphonium hexafluorophosphate

BOP-Cl: Bis-(2-oxo-3-oxazolidinyl)-phosphinic acid chloride

DIPEA: Diisopropyl ethyl amine

DMF: N,N-Dimethylformamide

EDCI: N-(3-Dimethylaminopropyl)-N'-ethyl-carbodiimide hydrochloride

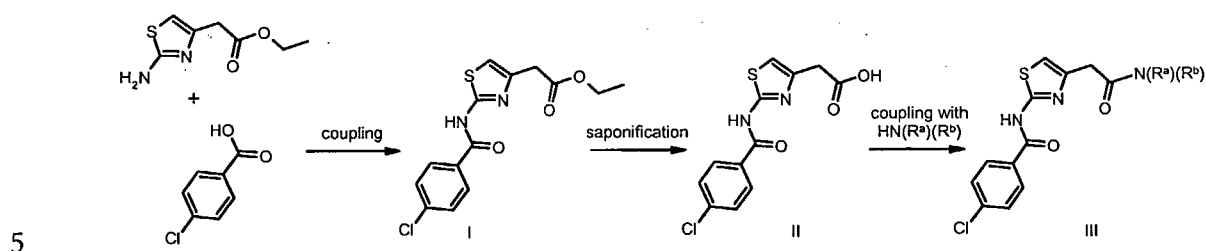
PyBOP: Benzotriazol-1-yl-oxytripyrrolidinephosphonium hexafluorophosphate

TEA: Triethylamine

TBTU: O-(Benzotriazol-1-yl)-N,N,N',N'-tetramethyluronium tetrafluoroborate

THF: Tetrahydrofurane

1. Synthesis of thiazole derivatives: route A



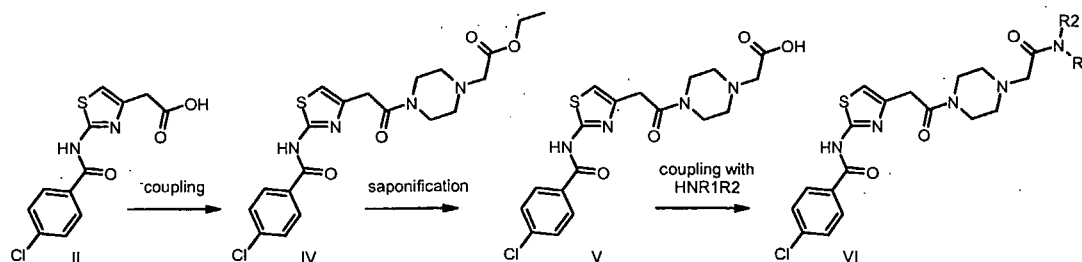
R^a and R^b in the scheme are as defined before.

10 The starting acid is dissolved in a suitable solvent such as CH_2Cl_2 , DMF, acetonitrile, THF and activated with an amide coupling reagent such as BOP, BOP-Cl, TBTU, EDCI/DMAP in the presence of a base like TEA, DIPEA, N-methylmorpholine etc. at 0 °C to 50 °C. After adding one to two equivalents 2-(2-aminothiazol-4-yl)-ethyl acetate the corresponding amide is obtained after reaction for 0.5-120 h at 0 °C to 50 °C. Preferred conditions are DMF, BOP and DIPEA.

15 Saponification of intermediate I is effected by dissolving it in a suitable solvent like MeOH, EtOH, THF, 1,4-dioxane, water or mixtures thereof and a base like LiOH, NaOH, KOH, Na_2CO_3 , K_2CO_3 or Cs_2CO_3 . Preferred conditions are NaOH in EtOH/ H_2O .

20 Intermediate II is then coupled with a primary or secondary amine or aniline $\text{HN}(\text{R}^a)(\text{R}^b)$ as described for the preparation of intermediate I. Preferred conditions are DMF, BOP and DIPEA or CH_2Cl_2 , TBTU and TEA.

2. Synthesis of thiazole derivatives: route B



In the scheme shown above, R^1 is hydrogen, C_{1-6} alkyl, C_{2-6} alkenyl or C_{2-6} alkynyl and R^2 is hydrogen, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{3-7} cycloalkyl, C_{1-6} alkyl or heterocyclyl, provided that R^2 can be C_{3-7} cycloalkyl, C_{1-6} alkyl or heterocyclyl, only when R^1 is hydrogen or C_{1-6} alkyl. R^1 and R^2 , together with the nitrogen atom to which they are attached, may also form a heterocyclyl. Both the heterocyclyl for R^2 and the heterocyclyl formed together by R^1 , R^2 , and the nitrogen atom to which they are attached, may optionally be substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} alkoxy, halogen, cyano, nitro, amino, mono- or di- C_{1-6} alkyl substituted amino, hydroxy, hydroxy C_{1-6} alkyl, aminocarbonyl, mono- or di- C_{1-6} alkyl substituted aminocarbonyl, halo C_{1-6} alkyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylsulfinyl, C_{1-6} alkylthio, amino C_{1-6} alkyl, mono- or di- C_{1-6} alkyl substituted amino C_{1-6} alkyl, aminosulfonyl and mono- or di- C_{1-6} alkyl substituted amino sulfonyl, and one or two carbon atoms of said heterocyclyl is optionally replaced with a carbonyl group.

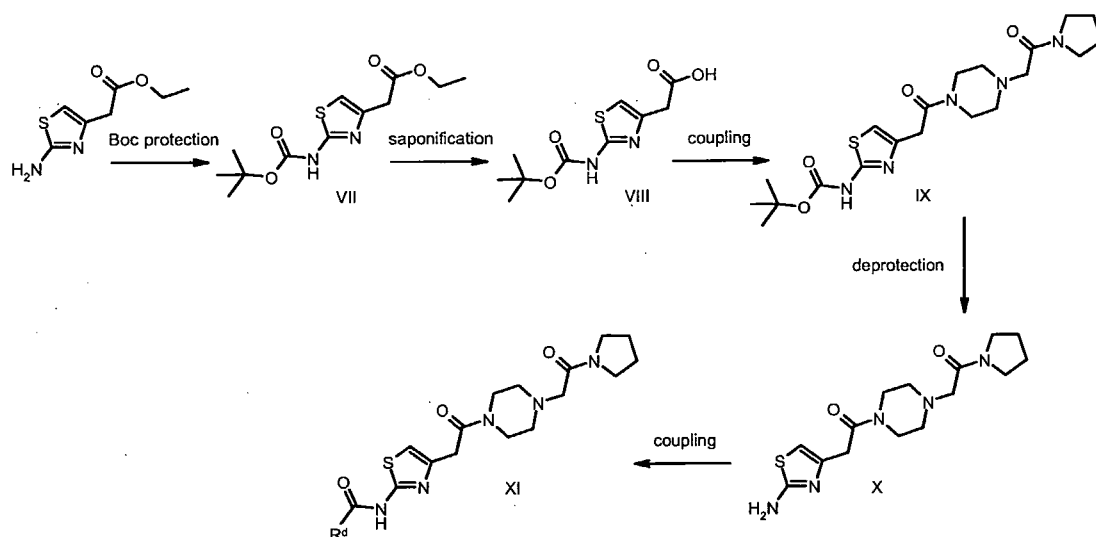
Intermediate II is coupled with 1-(ethoxycarbonylmethyl)-piperazine as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

Saponification of intermediate IV is effected as described for the preparation of intermediate II in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are NaOH in $H_2O/EtOH$.

Intermediate V is coupled with a primary or secondary amine as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A".

Preferred conditions are DMF, BOP and DIPEA or CH_2Cl_2 , TBTU and TEA.

3. Synthesis of thiazole derivatives: route C



5 R^d in the scheme is as defined before.

The starting 2-(2-aminothiazol-4-yl)-ethyl acetate is converted to the t-butyloxycarbonyl protected amine by reacting it with Boc_2O in a suitable solvent such as dichloromethane, acetonitrile, THF, DMF. An additive such as a catalytic amount of DMAP may be added. The Boc-protected intermediate VII is obtained
 10 after reaction for 0.5-120 h at 0 °C to 50 °C. Preferred conditions are CH_2Cl_2 and DMAP.

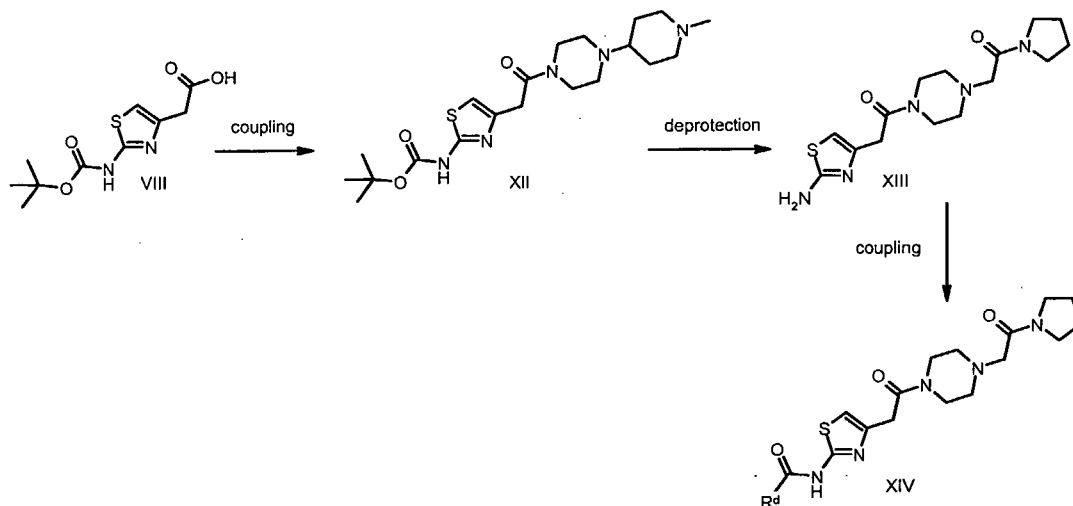
Saponification of intermediate VII is effected as described for the preparation of intermediate II in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are NaOH in $\text{H}_2\text{O}/\text{EtOH}$.

15 Intermediate VIII is coupled with 1-(pyrrolidinocarbonylmethyl)piperazine as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are CH_2Cl_2 , TBTU and TEA.

Deprotection of intermediate IX is then effected by treatment with a mineral acid such as HCl, HBr, H_2SO_4 or H_3PO_4 or a carbonic acid, in a solvent such as CH_2Cl_2 ,
 20 dioxane or HOAc at 0 to 60 °C. Preferred conditions are 4N HCl in dioxane.

Intermediate X is then coupled with an aryl carboxylic acid R^d -COOH as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are EDCI, DMAP and dichloromethane.

4. Synthesis of thiazole derivatives: route D



5

R^d in the scheme is as defined before.

Intermediate VIII is coupled with 1-(N-methylpiperidin-4-yl)piperazine as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

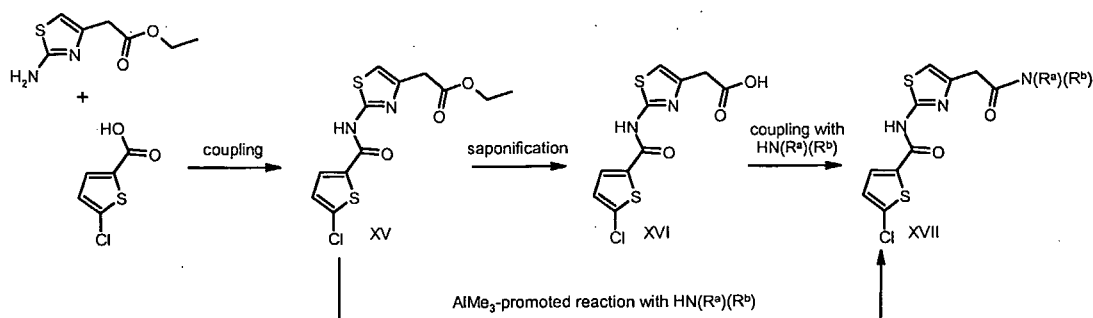
10

Deprotection of intermediate XII is then effected by treatment with a mineral acid such as HCl, HBr, H_2SO_4 or H_3PO_4 or a carbonic acid, in a solvent such as CH_2Cl_2 , dioxane or HOAc at 0 to 60 °C. Preferred conditions are HBr in HOAc.

15

Intermediate XIII is then coupled with an aryl carboxylic acid R^d -COOH as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are EDCI, DMAP and dichloromethane.

5. Synthesis of thiazole derivatives: route E



R^a and R^b in the scheme are as defined before.

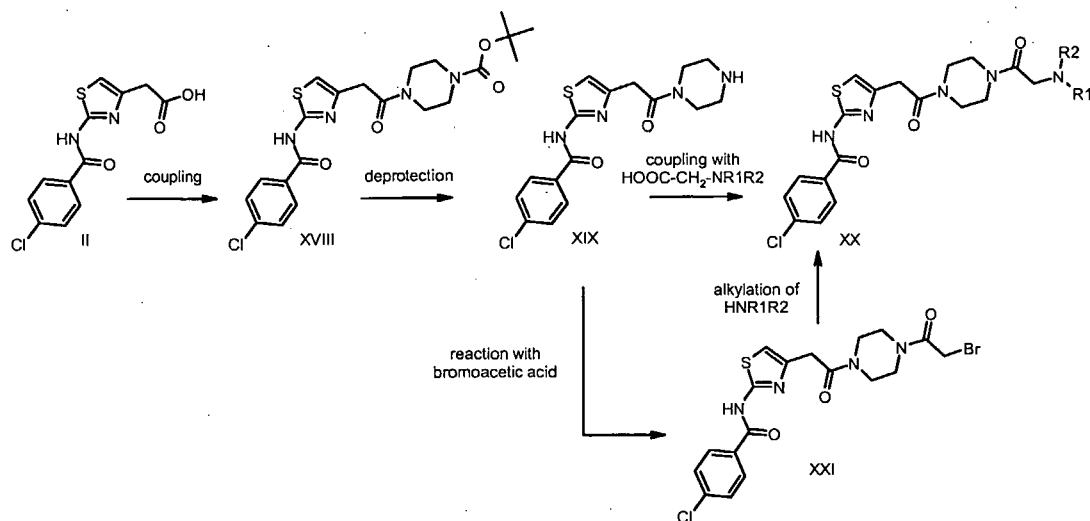
- 5 The starting 5-chlorothiophene-2-carboxylic acid is coupled with 2-(2-aminothiazol-4-yl)-ethyl acetate as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

- 10 Saponification of intermediate XV is then effected as described for the preparation of intermediate II in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are NaOH in $\text{H}_2\text{O}/\text{EtOH}$.

Intermediate XVI is coupled with an amine $\text{HN}(\text{R}^a)(\text{R}^b)$ as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

- 15 Alternatively, intermediate XV can be directly reacted with an aniline $\text{HN}(\text{R}^a)(\text{R}^b)$. Anilines are preactivated with AlMe_3 in a solvent such as toluene or dioxane at r.t. and subsequently treated with ester XV at elevated temperature (usually 90°C) to give the amide XVII.

6. Synthesis of thiazole derivatives: route F



In the scheme shown above, R¹ is hydrogen, C₁₋₆ alkyl, C₂₋₆ alkenyl or C₂₋₆ alkynyl and R² is hydrogen, C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₃₋₇ cycloalkyl, C₁₋₆ alkyl or heterocyclyl, provided that R² can be C₃₋₇ cycloalkyl, C₁₋₆ alkyl or heterocyclyl, only when R¹ is hydrogen or C₁₋₆ alkyl. R¹ and R², together with the nitrogen atom to which they are attached, may also form a heterocyclyl. Both the heterocyclyl for R² and the heterocyclyl formed together by R¹, R², and the nitrogen atom to which they are attached, may optionally be substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₁₋₆ alkoxy, halogen, cyano, nitro, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, amino C₁₋₆ alkyl, mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl, aminosulfonyl and mono- or di-C₁₋₆ alkyl substituted amino sulfonyl, and one or two carbon atoms of said heterocyclyl is optionally replaced with a carbonyl group.

Intermediate II is coupled with tert-butyl-1-piperazine carboxylate as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

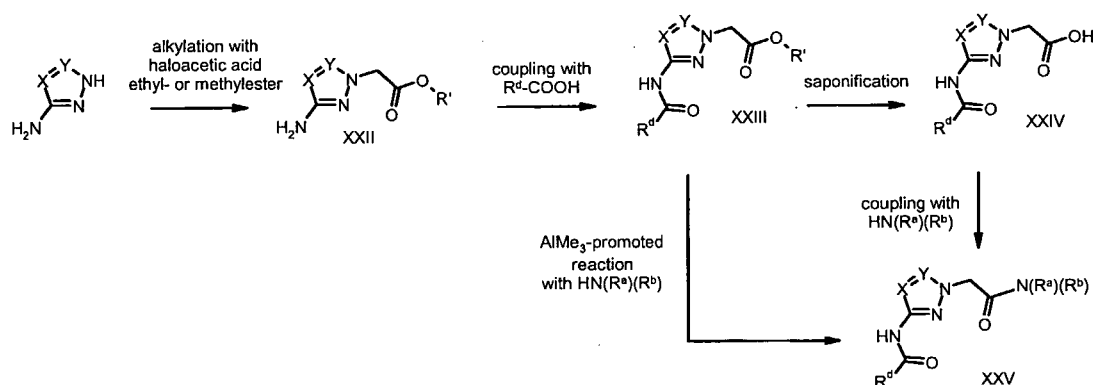
Deprotection of intermediate XVIII is then effected by treatment with a mineral acid such as HCl, HBr, H₂SO₄ or H₃PO₄ or a carbonic acid, in a solvent such as

CH₂Cl₂, dioxane or HOAc at 0 to 60 °C. Preferred conditions are 4N HCl in dioxane.

Intermediate XIX is coupled with glycine derivatives HOOC-CH₂-NR¹R² as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA.

Alternatively intermediate XIX is coupled with bromo acetic acid as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are DMF, BOP and DIPEA. The resulting α-bromoacetic acid amide is then treated with an excess of a primary or secondary amine in a suitable solvent such as CH₂Cl₂, THF, acetonitrile etc. in the presence of an organic base such as TEA, DIPEA etc. and reacted for 0.5-120 h at -20 °C to 50 °C.

7. Synthesis of pyrazole, triazole and tetrazole derivatives



R^a, R^b and R^d in the scheme are as defined before. Both X and Y are CH or both X and Y are N or X is N and Y is CH, and R' is methyl or ethyl.

The starting heterocycle is deprotonated with a base such as NaH or KOTBu in a suitable solvent such as DMF. Alternatively, a combination of KOH in MeOH may be used. The anion is reacted with a suitable alkylating agent such as ethyl iodoacetate, ethyl bromoacetate or methyl chloroacetate for 0.5-120 h at 0 °C to 50 °C.

Intermediate XXII is coupled with an aryl carboxylic acid R^d -COOH as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are dichloromethane, EDCI/DMAP and TEA.

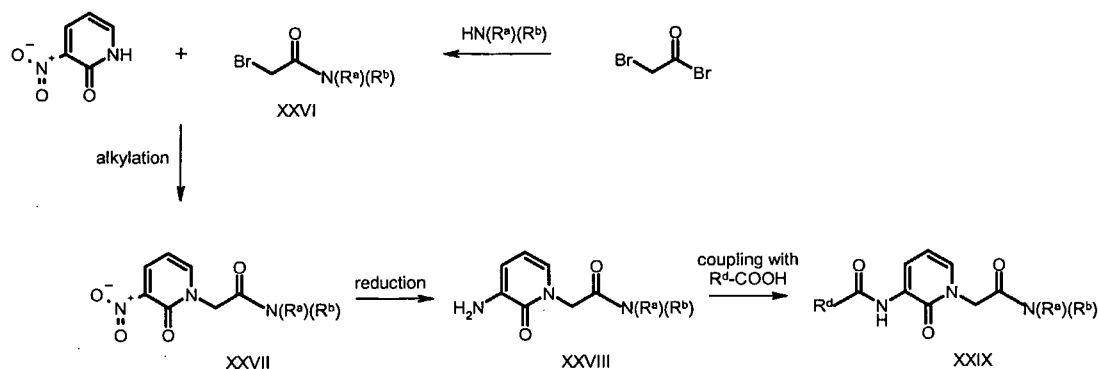
5 Saponification of intermediate XXIII is then effected as described for the preparation of intermediate II in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are NaOH in H_2O /EtOH.

10 Intermediate XXIV is coupled with an amine $HN(R^a)(R^b)$ as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A" to give amide XXV. Preferred conditions are DMF, BOP and DIPEA or MeCN, BOP-Cl and DIPEA.

Alternatively, intermediate XXIII can be directly reacted with an aniline $HN(R^a)(R^b)$. Anilines are preactivated with $AlMe_3$ in a solvent such as toluene or dioxane at r.t. and subsequently treated with ester XXIII at elevated temperature (usually 90 °C) to give the amide XXV.

15

8. Synthesis of pyridone derivatives



R^a , R^b and R^d in the scheme are as defined before.

20 Bromoacetic acid bromide is reacted with an amine $HN(R^a)(R^b)$ in a solvent such as THF, acetonitrile or CH_2Cl_2 in the presence of an organic base such as triethylamine or DIPEA for 0.5-120 h at 0 °C to 50 °C.

3-Nitro-pyridone is deprotonated with a base such as NaH or KOtBu in a suitable solvent such as DMF. The anion is reacted with bromide XXVI for 0.5-120 h at 0 °C to 50 °C.

The nitro group of intermediate XXVII is then reduced, preferably with zinc in acetic acid.

Intermediate XXVIII is coupled with an aryl acetic acid R^d-COOH as described for the preparation of intermediate I in "1. Synthesis of thiazole derivatives: route A". Preferred conditions are BOP, DIPEA and DMF.

As described above, the compounds of formula (I) are active compounds and inhibit the coagulation factor Xa. These compounds consequently influence both platelet activation which is induced by this factor and plasmatic blood coagulation. They therefore inhibit the formation of thrombi and can be used for the treatment and/or prevention of thrombotic disorders, such as, amongst others, arterial and venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease (PAOD), unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke (cerebral thrombosis) due to atrial fibrillation, inflammation and arteriosclerosis. The compounds of the present invention can also be used in the treatment of acute vessel closure associated with thrombolytic therapy and restenosis, e.g. after transluminal coronary angioplasty (PTCA) or bypass grafting of the coronary or peripheral arteries and in the maintenance of vascular access patency in long term hemodialysis patients. F.Xa inhibitors of this invention may form part of a combination therapy with an anticoagulant with a different mode of action or with a platelet aggregation inhibitor or with a thrombolytic agent. Furthermore, these compounds have an effect on tumour cells and prevent metastases. They can therefore also be used as antitumour agents.

Prevention and/or treatment of thrombotic disorders, particularly arterial or deep vein thrombosis, is the preferred indication.

The invention therefore also relates to pharmaceutical compositions comprising a compound as defined above and a pharmaceutically acceptable excipient.

The invention likewise embraces compounds as described above for use as therapeutically active substances, especially as therapeutically active substances for the treatment and/or prophylaxis of diseases which are associated with the

coagulation factor Xa, particularly as therapeutically active substances for the treatment and/or prophylaxis of thrombotic disorders, arterial thrombosis, venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease, unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke due to atrial fibrillation, inflammation, arteriosclerosis, acute vessel closure associated with thrombolytic therapy or restenosis, and/or tumour.

In another preferred embodiment, the invention relates to a method for the therapeutic and/or prophylactic treatment of diseases which are associated with the coagulation factor Xa, particularly for the therapeutic and/or prophylactic treatment of thrombotic disorders, arterial thrombosis, venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease, unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke due to atrial fibrillation, inflammation, arteriosclerosis, acute vessel closure associated with thrombolytic therapy or restenosis, and/or tumour, which method comprises administering a compound as defined above to a human being or animal.

The invention also embraces the use of compounds as defined above for the therapeutic and/or prophylactic treatment of diseases which are associated with the coagulation factor Xa, particularly for the therapeutic and/or prophylactic treatment of thrombotic disorders, arterial thrombosis, venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease, unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke due to atrial fibrillation, inflammation, arteriosclerosis, acute vessel closure associated with thrombolytic therapy or restenosis, and/or tumour.

The invention also relates to the use of compounds as described above for the preparation of medicaments for the therapeutic and/or prophylactic treatment of diseases which are associated with the coagulation factor Xa, particularly for the therapeutic and/or prophylactic treatment of thrombotic disorders, arterial thrombosis, venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease, unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke due to atrial fibrillation, inflammation, arteriosclerosis, acute vessel closure associated with thrombolytic therapy or restenosis, and/or tumour. Such medicaments comprise a compound as described above.

The inhibition of the coagulation factor Xa by the compounds of the present invention can be demonstrated with the aid of a chromogenic peptide substrate assay as described hereinafter.

Factor Xa activity was measured spectrophotometrically in microtiter plates in a final volume of 150 μ l using the following conditions: Inhibition of human factor Xa (Enzyme Research Laboratories) was tested at an enzyme concentration of 3 nM using the chromogenic substrate S-2222 (Chromogenix AB, Mölndal, Sweden) at 200 nM. The reaction kinetics of the enzyme and the substrate were linear with both time and the enzyme concentration. The inhibitors were dissolved in DMSO and tested at various concentrations up to 100 μ M. The inhibitors were diluted using HNPT buffer consisting of HEPES 100mM, NaCl 140mM, PEG 6000 0.1% and Tween 80 0.02%, pH 7.8. The cleavage of S-2222 by human factor Xa was followed at 405 nm for 5 minutes at room temperature. The velocity of the reaction was determined by the autoreader from the slope of the linear regression fit to 7 time points (1 minute). The initial velocity for each inhibitor concentration was determined by the slope of at least 4 time points in the linear phase by a linear regression fit (mOD/min^2). Apparent dissociation constants K_i were calculated according to Cheng and Prusoff [Cheng, Y. C.; Prusoff, W. H. Relationship between the inhibition constant (K_i) and the concentration of the inhibitor that causes 50 percent inhibition (IC_{50}) of an enzyme reaction. *Biochem. Pharmacol.* 1973, 22, 3099-3108.] based on the IC_{50} and the respective K_m , determined previously ($K_i = \text{IC}_{50} / (1 + S/K_m)$). The K_m for the substrate used was determined under the conditions of the test with at least 5 substrate concentrations ranging from 0.5 to 15 times K_m . [Lottenberg R, Hall JA, Blinder M, Binder EP, Jackson CM., The action of thrombin on peptide p-nitroanilide substrates. Substrate selectivity and examination of hydrolysis under different reaction conditions. *Biochim Biophys Acta.* 1983 Feb 15; 742(3):539-57]. According to Eadie [Eadie G.S. The inhibition of cholinesterase by physostigmine and prostigmine. *J. Biol. Chem.* 1942, 146, 85-93.], the K_m for S-2222 amounted to 613 μ M.

The activity of the low molecular weight substances can, moreover, be characterized in the "prothrombin time" (PT) clotting test. The substances are prepared as a 10 mM solution in DMSO and thereafter made up to the desired dilution in the same solvent. Thereafter, 0.25 ml of human plasma (obtained from whole blood anticoagulated with 1/10 volume of 108 mM Na citrate) was placed in the

instrument-specific sample container. In each case 5 µl of each dilution of the substance-dilution series was then mixed with the plasma provided. This plasma/inhibitor mixture was incubated at 37 °C for 2 minutes. Thereafter, there were pipetted to the semi-automatic device (ACL, Automated Coagulation Laboratory (Instrument Laboratory)) 50 µl of plasma/ inhibitor mixture in the measurement container. The clotting reaction was initiated by the addition of 0.1 ml of Dade® Innovin® (recombinant human tissue factor combined with calcium buffer and synthetic phospholipids, Dade Behring, Inc., Cat. B4212-50). The time up to the fibrin cross-linking was determined photooptically from the ACL. The inhibitor concentration, which brought about a doubling of the PT clotting time, was determined by fitting the data to an exponential regression (XLfit).

The compounds of the present invention can furthermore be characterised by the Activated Partial Thromboplastin time (aPTT). This coagulation test can e.g. be run on the ACL 300 Coagulation System (Instrumentation Laboratory) automatic analyzer. The substances are prepared as a 10 mM solution in DMSO and thereafter made up to the desired dilution in the same solvent. The test is performed with the Dade® Actin® FS Activated PTT reagent (purified soy phosphatides in 1.0×10^{-4} M ellagic acid, stabilizers and preservative, Dade Behring, Inc., Cat. B4218-100). Thereafter, 0.25 ml aliquots of human plasma (obtained from whole blood anticoagulated with 1/10 volume of 108 mM Na citrate) are spiked with 5 µl of test compound in at least 6 concentrations. 50 µl plasma at 4 °C containing 1/50 vol. inhibitor in solvent are incubated with 50 µl Dade® Actin® FS Activated PTT reagent in water at 37 °C for 3 min., then 50 µl CaCl₂·2H₂O 25 mM in water at 37 °C are added. The time up to the fibrin cross-linking was determined photooptically from the ACL. The inhibitor concentration, which brought about a doubling of the APTT clotting time, was determined by fitting the data to an exponential regression (XLfit).

The K_i values of the active compounds of the present invention preferably amount to about 0.001 to 50 µM, especially about 0.001 to 1 µM. The PT values preferably amount to about 0.5 to 100 µM, especially to about 0.5 to 10 µM. The aPTT values preferably amount to about 0.5 to 100 µM, especially to about 0.5 to 10 µM.

Example	Ki [μ M] factor Xa
Ex. 37.5	0.062
Ex. 47.3	0.026
Ex. 61.4	0.006

The compounds of formula I and/or their pharmaceutically acceptable salts can be used as medicaments, e.g. in the form of pharmaceutical preparations for enteral, parenteral or topical administration. They can be administered, for example, perorally, e.g. in the form of tablets, coated tablets, dragées, hard and soft gelatine capsules, solutions, emulsions or suspensions, rectally, e.g. in the form of suppositories, parenterally, e.g. in the form of injection solutions or suspensions or infusion solutions, or topically, e.g. in the form of ointments, creams or oils. Oral administration is preferred.

The production of the pharmaceutical preparations can be effected in a manner which will be familiar to any person skilled in the art by bringing the described compounds of formula I and/or their pharmaceutically acceptable salts, optionally in combination with other therapeutically valuable substances, into a galenical administration form together with suitable, non-toxic, inert, therapeutically compatible solid or liquid carrier materials and, if desired, usual pharmaceutical adjuvants.

Suitable carrier materials are not only inorganic carrier materials, but also organic carrier materials. Thus, for example, lactose, corn starch or derivatives thereof, talc, stearic acid or its salts can be used as carrier materials for tablets, coated tablets, dragées and hard gelatine capsules. Suitable carrier materials for soft gelatine capsules are, for example, vegetable oils, waxes, fats and semi-solid and liquid polyols (depending on the nature of the active ingredient no carriers might, however, be required in the case of soft gelatine capsules). Suitable carrier materials for the production of solutions and syrups are, for example, water, polyols, sucrose, invert sugar. Suitable carrier materials for injection solutions are, for example, water, alcohols, polyols, glycerol and vegetable oils. Suitable carrier materials for

suppositories are, for example, natural or hardened oils, waxes, fats and semi-liquid or liquid polyols. Suitable carrier materials for topical preparations are glycerides, semi-synthetic and synthetic glycerides, hydrogenated oils, liquid waxes, liquid paraffins, liquid fatty alcohols, sterols, polyethylene glycols and cellulose derivatives.

Usual stabilizers, preservatives, wetting and emulsifying agents, consistency-improving agents, flavour-improving agents, salts for varying the osmotic pressure, buffer substances, solubilizers, colorants and masking agents and antioxidants come into consideration as pharmaceutical adjuvants.

The dosage of the compounds of formula I can vary within wide limits depending on the disease to be controlled, the age and the individual condition of the patient and the mode of administration, and will, of course, be fitted to the individual requirements in each particular case. For adult patients a daily dosage of about 1 to 1000 mg, especially about 1 to 300 mg, comes into consideration. Depending on severity of the disease and the precise pharmacokinetic profile the compound could be administered with one or several daily dosage units, e.g. in 1 to 3 dosage units.

The pharmaceutical preparations conveniently contain about 1-500 mg, preferably 1-100 mg, of a compound of formula I.

The following Examples serve to illustrate the present invention in more detail. They are, however, not intended to limit its scope in any manner.

ExamplesGeneral ProceduresGeneral Procedure A: Coupling of a carboxylic acid with an amine using BOP as a coupling reagent

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To a stirred solution of the acid (1 eq) in DMF is added the amine (1.2-2 eq), N-ethyl-diisopropylamine (3-4 eq) and then BOP-reagent (1.2-1.5 eq). The mixture is stirred at r.t. under an argon atmosphere for 3-24 h. The mixture is diluted with EtOAc, washed with water and brine, dried (MgSO₄), filtered and concentrated. The crude product can be purified by chromatography (silicagel) or by crystallization.

10

General Procedure B: Coupling of a carboxylic acid with an amine using BOP-Cl as a coupling reagent

15

To a stirred solution of the acid (1 eq) in MeCN is added the amine (1.1 eq), N-ethyl-diisopropylamine (3 eq) and then BOP-Cl (1.05-2 eq). The mixture is stirred at r.t. under an argon atmosphere for 3-24 h. The mixture is diluted with EtOAc, washed with water and brine, dried (MgSO₄), filtered and concentrated. The crude product is purified by chromatography (silicagel).

20

General Procedure C: Coupling of a carboxylic acid with an amine using TBTU as a coupling reagent

25

To a stirred solution of the acid (1 eq) in dichloromethane is added the amine (1.2 eq), triethylamine (2 eq) and then TBTU (1.2 eq). The mixture is stirred at r.t. under an argon atmosphere for 3-24 h. The mixture is diluted with dichloromethane, washed with saturated ammonium chloride solution, water and brine, dried (MgSO₄), filtered and concentrated. The crude product is purified by chromatography (silicagel).

30

General Procedure D: Coupling of a carboxylic acid with an amine using EDCI/DMAP as a coupling reagent

5 To a stirred solution of the amine (1 eq) in dichloromethane/DMF 3:1 is added the acid (1.2 eq), triethylamine (2 eq), DMAP (0.5 eq) and then EDCI (2 eq). The mixture is then stirred at r.t. under an argon atmosphere for 24-96 h, then evaporated to dryness. The residue is taken up in 1N NaOH and washed with EtOAc. The aqueous phase is extracted several times with CH₂Cl₂/MeOH 9:1. The
10 organic layer is dried (MgSO₄), filtered and concentrated. The crude product is purified by chromatography (silicagel).

General Procedure E: Hydrolysis of a carboxylic acid ester to the the corresponding carboxylic acid

15

The starting ester (1 eq) was dissolved in EtOH/H₂O 1:1 or MeOH/H₂O 1:1 to give a 5 - 10% solution which was treated at 0 °C with solid NaOH (3 eq). The reaction mixture was stirred at r.t. for 2-24 hrs. The EtOH was removed in the vacuum. The remaining aqueous solution was washed with diethyl ether, then acidified with
20 3N HCl. In some case the product precipitated upon acidification. In this case, the solid was filtered off and dried in the high vacuum. If no precipitation occurred, the acidic aqueous layer was extracted with EtOAc. The organic layer was washed with water and brine, then dried (MgSO₄). The product can be purified by crystallization of by chromatography (silicagel).

25

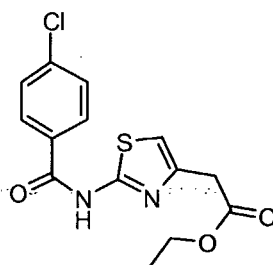
General Procedure F: Conversion of a carboxylic acid ester to an aryl amide using AlMe₃ activation

30 The starting aniline (1.2-4 eq) was dissolved in toluene or dioxane to give a 5-10% solution which was treated under an argon atmosphere at r.t. with AlMe₃ in heptane (1.2-4 eq). The reaction mixture was stirred at r.t. 90 min. Then the ester (1 eq) was added. The temperature was raised to 90°. Stirring was continued for 3-

5 hrs. The reaction mixture was cooled to r.t., then concentrated. The residue was taken up in EtOAc and washed with 1N HCl. The organic layer was dried (MgSO₄), filtered and concentrated. The product can be purified by crystallization or by chromatography (silicagel).

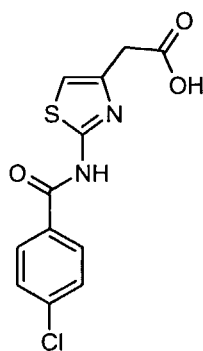
5 Example 1

1.1 Using general procedure A, 4-chlorobenzoic acid and 2-(2-aminothiazol-4-yl)-ethyl acetate were coupled to give [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid ethyl ester. Light yellow solid. MS 325.3 ([M+H]⁺)



10

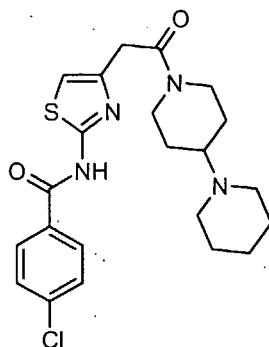
1.2 Using general procedure E, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid ethyl ester was hydrolyzed to give [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid. Colorless solid. MS 295.5 ([M-H]⁻)



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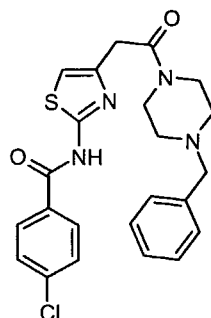
1.3 Using general method A, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid was coupled with 4-piperidino piperidine give to [4-(2-[1,4']-bipiperidinyl-1'-yl-2-oxo-ethyl)-thiazol-2-yl]-4-chloro-benzamide. Colorless solid. MS 447 ([M])

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Example 2

- 5 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-benzyl-piperazine to give N-{4-[2-(4-benzyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-4-chloro-benzamide, using general method A. Orange solid. MS 455.4 ($[M+H]^+$)

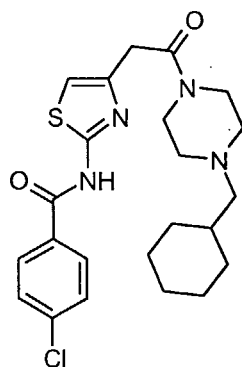


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Example 3

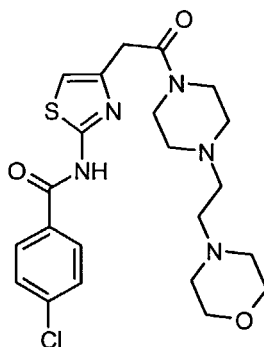
- In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with (1-cyclohexyl-methyl)piperazine to give 4-chloro-N-{4-[2-(4-cyclohexylmethyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide, using general procedure A. Colorless amorphous solid. MS 461.0 ($[M+H]^+$)
- 15

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Example 4

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(2-[4-morpholino]-ethyl)-piperazine to give 4-chloro-N-(4-{2-[4-(2-morpholin-4-yl-ethyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide, using general procedure A. Colorless amorphous solid. MS 478.1 ($[M+H]^+$)



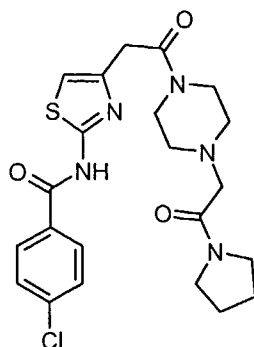
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Example 5

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(pyrrolidinocarbonylmethyl)piperazine to give 4-chloro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide, using general procedure A. Off-white solid. MS 476.1 ($[M+H]^+$)

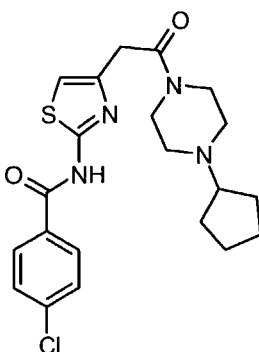
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Example 6

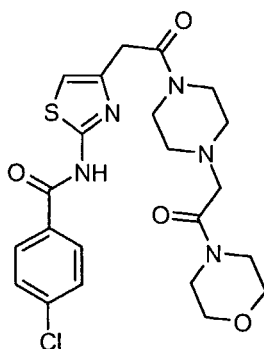
5 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-cyclopentyl-piperazine to give 4-chloro-{4-[2-(4-cyclopentyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide, using general procedure A. Off-white solid. MS 433.3 ($[M+H]^+$)



10 Example 7

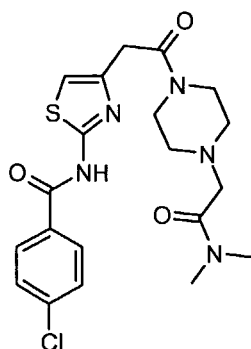
In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(4-morpholino)-2-piperazinoethanone to give 4-chloro-N-(4-{2-[4-(2-morpholin-4-yl-2-oxo-ethyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide, using general procedure A. Amorphous off-white solid.
15 MS 492.3 ($[M+H]^+$)

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Example 8

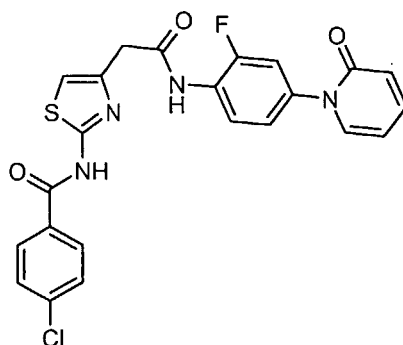
5 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with piperazino-acetic acid N,N-dimethylamide to give 4-chloro-N-{4-[2-(4-dimethylcarbamoylmethyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-benzamide, using general procedure A. Amorphous white solid. MS 450.0 ($[M+H]^+$)



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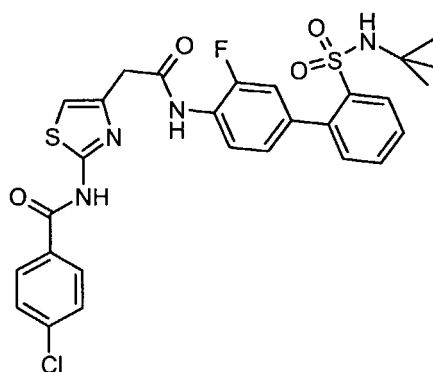
Example 9

15 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(4-amino-3-fluoro-phenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et al., patent application WO 2003045912) to give 4-chloro-N-(4-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure B. Off-white solid. MS 483.3 ($[M+H]^+$)



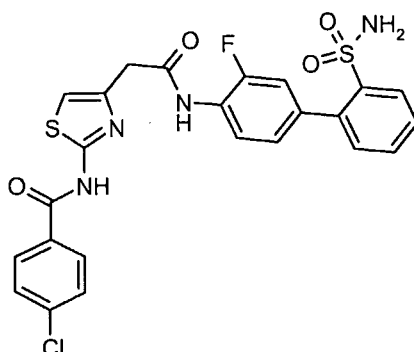
Example 10

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 4'-amino-3'-fluoro-biphenyl-2-sulfonic acid tert-butylamide (CAS 209919-51-7, prepared according to B.-Y. Zhu et al., patent application WO 2000071515) to give N-{4-[(2'-tert-butylsulfamoyl-3-fluoro-biphenyl-4-yl)carbamoyl]-methyl}-thiazol-2-yl}-4-chloro-benzamide, using general procedure C. White amorphous solid. MS 601.3 ($[M+H]^+$)



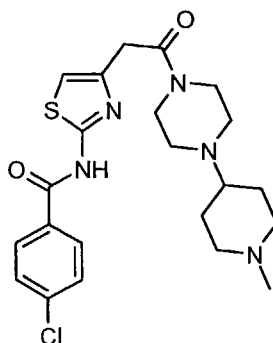
A solution of 163 mg N-{4-[(2'-tert-butylsulfamoyl-3-fluoro-biphenyl-4-yl)carbamoyl]-methyl}-thiazol-2-yl}-4-chloro-benzamide in 8 ml $CHCl_3/MeOH$ 3:1 was cooled to $-10^\circ C$. A stream of HCl gas was passed over the stirred solution for 10 min. The reaction mixture was kept at $4^\circ C$ over night, then concentrated. The crude product was purified by chromatography on silica using a gradient from CH_2Cl_2 to $CH_2Cl_2/MeOH$ 9:1 in 20 minutes to give 112 mg 4-chloro-N-{4-[(3-

fluoro-2'-sulfamoyl-biphenyl-4-ylcarbamoyl)-methyl]-thiazol-2-yl}-benzamide as white solid. MS 545.3 ($[M+H]^+$)



5 Example 11

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(N-methylpiperidin-4-yl)piperazine to give 4-chloro-N-(4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide, using general procedure C. Off-white solid. MS 462.3 ($[M+H]^+$)



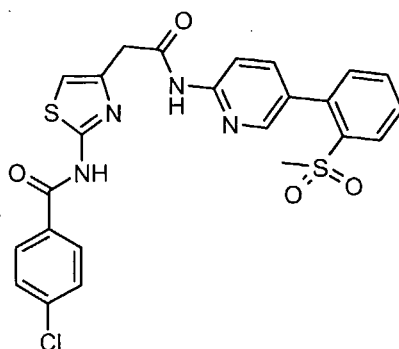
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Example 12

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 5-(2-methanesulfonyl-phenyl)-pyridin-2-ylamine, hydrochloride (CAS 209959-31-9) to give 4-chloro-N-(4-{[5-(2-methanesulfonyl-phenyl)-pyridin-2-ylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure C. White solid. MS 527.2 ($[M+H]^+$)

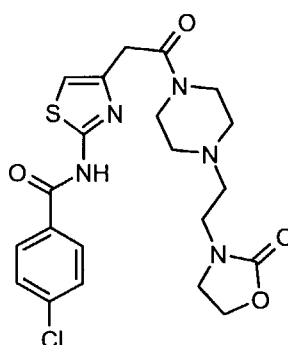
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Example 13

5 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 3-[2-(1-piperazinyl)ethyl]-2-oxazolidinone hydrochloride (CAS 52548-39-7) to give 4-chloro-N-[4-(2-oxo-2-{4-[2-(2-oxo-oxazolidin-3-yl)-ethyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide, using general procedure C. White amorphous solid. MS 478.4 ($[M+H]^+$)

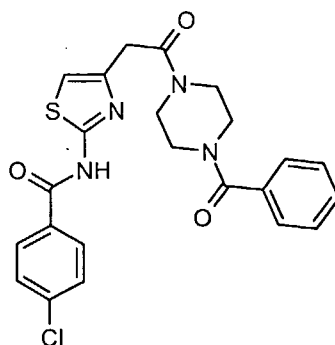


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Example 14

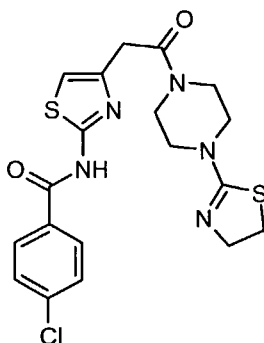
15 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with phenyl-piperazin-1-yl-methanone (CAS 13754-38-6) to give N-{4-[2-(4-benzoyl-piperazin-1-yl)-2-oxo-ethyl]-thiazol-2-yl}-4-chloro-benzamide, using general procedure C. White solid. MS 469.3 ($[M+H]^+$)

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Example 15

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 2-(piperazino)-2-thiazoline dihydrochloride to give 4-chloro-N-(4-{2-[4-(4,5-dihydro-thiazol-2-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide, using general procedure C. White solid. MS 450.0 ([M+H]⁺)



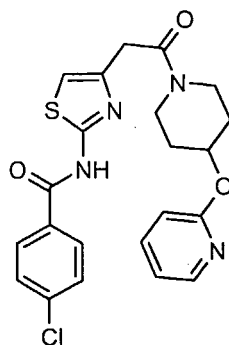
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Example 16

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 2-(piperidin-4-yloxy)-pyridine dihydrochloride (CAS 313490-36-7) to give 4-chloro-N-(4-{2-oxo-2-[4-(pyridin-2-yloxy)-piperidin-1-yl]-ethyl}-thiazol-2-yl)-benzamide, using general procedure C. White amorphous solid. MS 457.6 ([M+H]⁺)

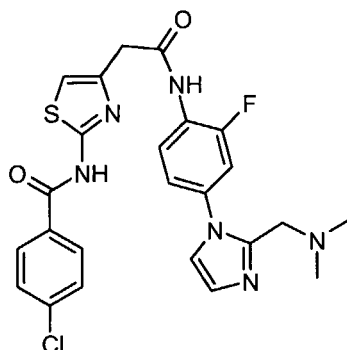
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Example 17

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 4-(2-dimethylaminomethyl-imidazol-1-yl)-2-fluoro-phenylamine (CAS 218301-68-9, prepared according to US 02/38168) to give: 4-chloro-(4-{[4-(2-dimethylaminomethyl-imidazol-1-yl)-2-fluoro-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure A. Off-white solid. MS 511.4 ([M-H]⁻)

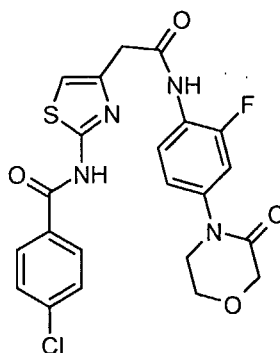


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Example 18

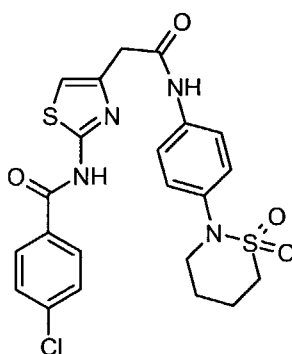
In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 4-(4-amino-3-fluoro-phenyl)-morpholin-3-one (CAS 742073-22-9) to give 4-chloro-(4-{[2-fluoro-4-(3-oxo-morpholin-4-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure A. Off-white solid. MS 489.3 ([M+H]⁺)

15



Example 19

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 4-(1,1-dioxo-[1,2]thiazinan-2-yl)-phenylamine hydrochloride (CAS 37441-49-9) to give 4-chloro-(4-{[4-(1,1-dioxo-[1,2]thiazinan-2-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure A. Yellow solid. MS 505.4 ($[M+H]^+$)



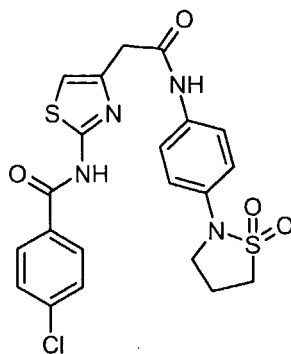
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Example 20

In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 4-(1,1-dioxo-isothiazolidin-2-yl)-phenylamine, hydrochlorid (CAS 90556-91-5) to give 4-chloro-(4-{[4-(1,1-dioxo-isothiazolidin-2-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-benzamide, using general procedure A. Light yellow solid. MS 491.3 ($[M+H]^+$)

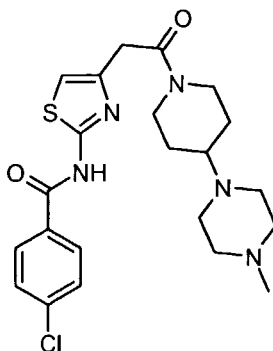
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Example 21

5 In analogy to example 1.3, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-methyl-4-(piperidin-4-yl)-piperazine to give 4-chloro-(4-{2-[4-(4-methyl-piperazin-1-yl)-piperidin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide, using general procedure A. White solid. MS 462.4 ($[M+H]^+$)

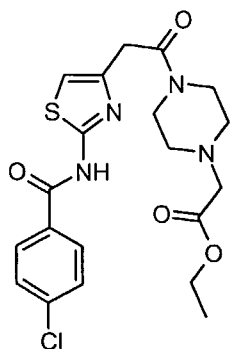


10 Example 22

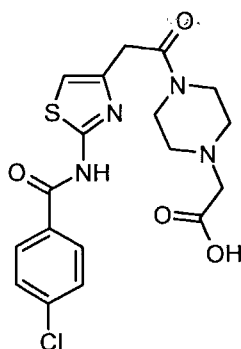
22.1 Using general procedure A, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid (example 1.2) was coupled with 1-(ethoxycarbonylmethyl)-piperazine to give (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid ethyl ester. Off-white solid. MS 473.1 ($[M+Na]^+$)

15

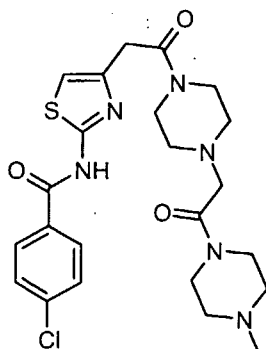
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22.2 Using general procedure E, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-
acetyl}-piperazin-1-yl)-acetic acid ethyl ester was hydrolyzed to (4-{2-[2-(4-chloro-
5 benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid. Off-white solid.
MS 423.1 ($[M+H]^+$)

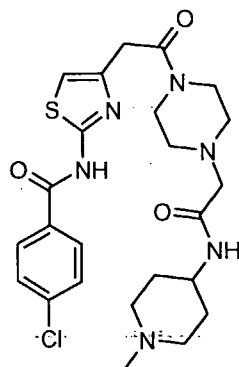


22.3 Using general procedure A, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-
10 acetyl}-piperazin-1-yl)-acetic acid was coupled with 1-methyl piperazine to give 4-
chloro-N-[4-(2-{4-[2-(4-methyl-piperazin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-
oxo-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 505.3 ([M+H]⁺)



Example 23

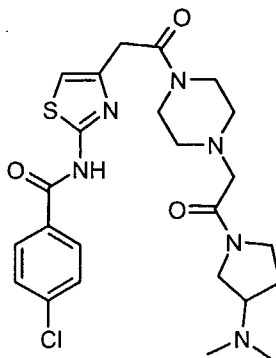
In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with 4-amino-1-methylpiperidine, using general method A, using THF instead of DMF as solvent, to give 4-chloro-N-[4-(2-{4-[(1-methyl-piperidin-4-ylcarbamoyl)-methyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 519.3 ($[M+H]^+$)



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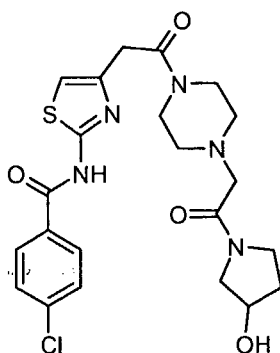
Example 24

In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with 3-dimethylaminopyrrolidine, using general method A, using THF instead of DMF as solvent, to give 4-chloro-(RS)-[4-(2-{4-[2-(3-dimethylamino-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Off-white solid. MS 519.5 ($[M]$)



Example 25

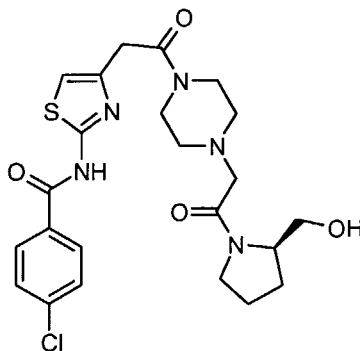
5 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with 3-pyrrolidinol, using general method A, using THF instead of DMF as solvent, to give 4-chloro-(RS)-[4-(2-{4-[2-(3-hydroxy-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Off-white solid. MS 492.3 ([M])



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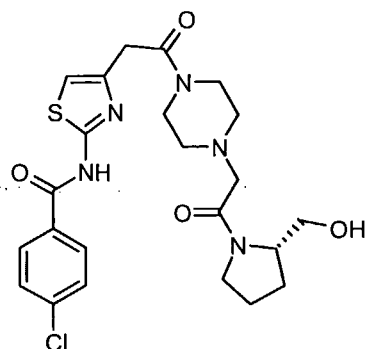
Example 26

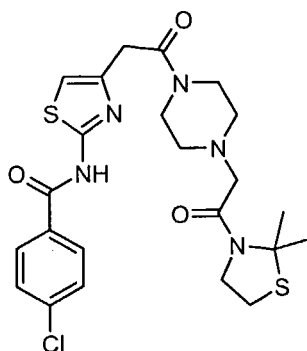
15 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with (R)-(-)-2-(hydroxymethyl)pyrrolidine using general method A using THF instead of DMF as solvent to give 4-chloro-[4-(2-{4-[2-((R)-2-hydroxymethyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Off-white solid. MS 506.4 ([M])



Example 27

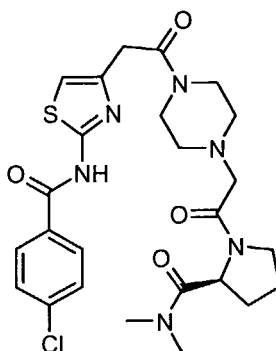
5 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with (S)-(+)-2-(hydroxymethyl)pyrrolidine, using general method A, using THF instead of DMF as solvent, to give 4-chloro-[4-(2-{4-[2-((S)-2-hydroxymethyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Off-white solid. MS 506.4 ([M])





Example 29

- 5 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with H-Pro-NMe₂, using general method C, to give (S)-1-[2-(4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidine-2-carboxylic acid dimethylamide. Off-white solid. MS 547.5 ([M+H]⁺)

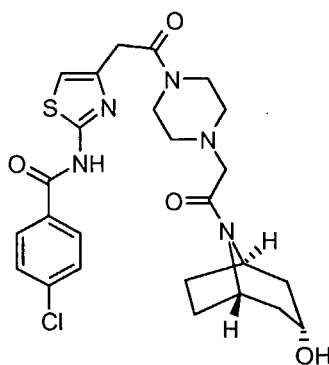


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Example 30

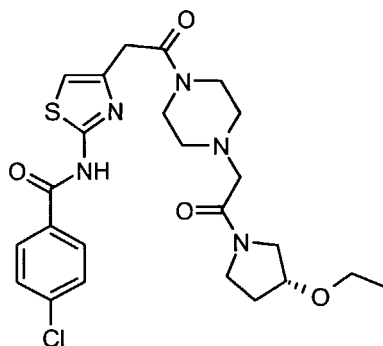
- 15 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with nortropine, using general method C, to give 4-chloro-[4-(2-{4-[2-((1S,3R,5R)-3-hydroxy-8-aza-bicyclo[3.2.1]oct-8-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 532.3 ([M+H]⁺)

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Example 31

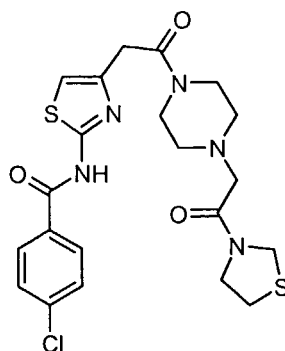
- 5 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with (R)-3-ethoxy pyrrolidine, using general method C, to give 4-chloro-[4-(2-{4-[2-((R)-3-ethoxy-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Light yellow solid. MS 542.2 ($[M+Na]^+$)



10

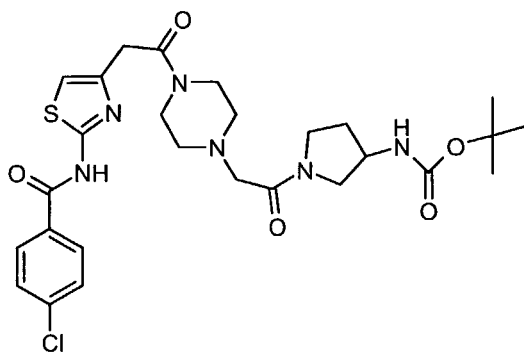
Example 32

- 15 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with thiazolidine, using general method C, with PyBOP instead of TBTU as coupling reagent, to give 4-chloro-(4-{2-oxo-2-[4-(2-oxo-2-thiazolidin-3-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide. Light yellow solid. MS 494.4 ($[M+H]^+$)



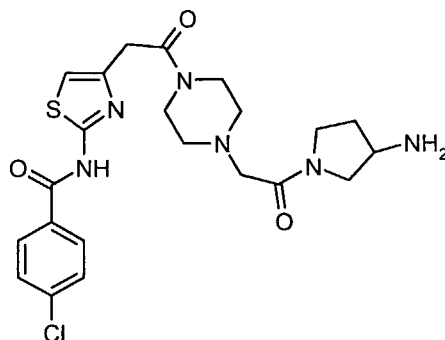
Example 33

- 5 In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with 3-(tert-butylloxycarbonylamino)pyrrolidine, using general method C, to give {1-[2-(4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidin-3-yl}-carbamic acid tert-butyl ester. Off-white solid. MS 591.3
- 10 ($[M+H]^+$)



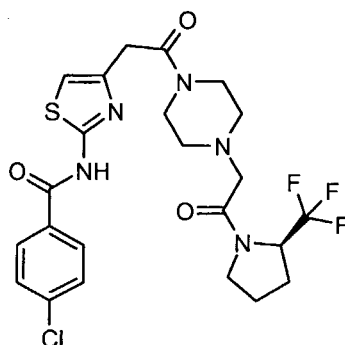
- 15 A solution of 180 mg {1-[2-(4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidin-3-yl}-carbamic acid tert-butyl ester in 2 ml MeOH was cooled to 0 °C, then treated with 1.5 ml 4M HCl in dioxane. The reaction mixture was stirred over night at r.t., then concentrated. The residue was taken up in 5 ml 1N aqueous HCl and washed with diethylether. The aqueous layer was brought to pH 12 with 4N NaOH and extracted with EtOAc, then with CH₂Cl₂/MeOH 9:1. The combined organic layers were washed with brine, dried

(MgSO₄), filtered and concentrated. The crude product was purified by chromatography on silica using a gradient from CH₂Cl₂ to CH₂Cl₂/MeOH 85:15 in 20 min to give 25 mg [4-(2-{4-[2-(3-amino-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-4-chloro-benzamide as light yellow solid. MS 491.5 ([M+H]⁺)



Example 34

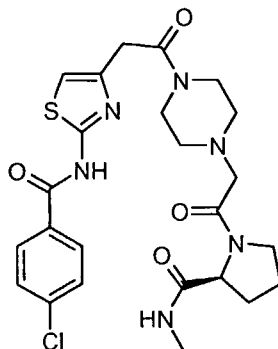
In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with (S)-2-(trifluoromethyl)pyrrolidine, using general method C, to give 4-chloro-[4-(2-oxo-2-{4-[2-oxo-2-((R)-2-trifluoromethyl-pyrrolidin-1-yl)-ethyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 543.8 ([M+H]⁺)



Example 35

In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with H-Pro-NHMe,

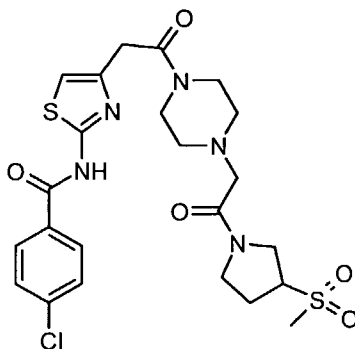
using general method C, to give (S)-1-[2-(4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetyl]-pyrrolidine-2-carboxylic acid methylamide. White solid. MS 533.3 ($[M+H]^+$)



5

Example 36

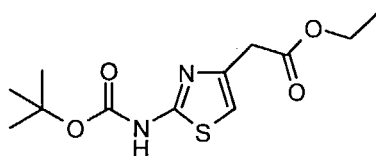
In analogy to example 22.3, (4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazin-1-yl)-acetic acid (example 22.2) was coupled with (RS)-3-(methylsulfonyl)pyrrolidine, using general method C, to give 4-chloro-(RS)-[4-(2-{4-[2-(3-methanesulfonyl-pyrrolidin-1-yl)-2-oxo-ethyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. Off-white solid. MS 554.2 ($[M+H]^+$)



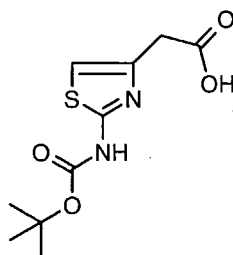
Example 37

37.1 A solution of 30 g 2-(2-aminothiazol-4-yl)-ethyl acetate in 200 ml CH_2Cl_2 was treated at 0 °C with 2.9 g DMAP under an argon atmosphere. A solution of 38.9 g Boc_2O in 50 ml CH_2Cl_2 was then added dropwise for 30 min. The resulting

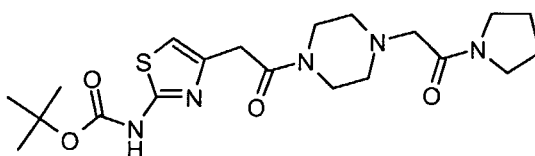
suspension was stirred at r.t. overnight. The reaction mixture was then washed with 5 % aq. KHCO_3 , H_2O , sat. aq. NH_4Cl and brine, dried (MgSO_4), filtered and concentrated to leave the crude product as a brown viscous oil. The product was isolated by chromatography on silica using EtOAc/cyclohexane 1:2 to give 40.5 g (2-tert-butoxycarbonylamino-thiazol-4-yl)-acetic acid ethyl ester as orange viscous oil. MS 287.0 ($[\text{M}+\text{H}]^+$)



37.2 Using general procedure E, (2-tert-butoxycarbonylamino-thiazol-4-yl)-acetic acid ethyl ester was hydrolyzed to (2-tert-butoxycarbonylamino-thiazol-4-yl)-acetic acid. Colorless crystalline solid. MS 259.0 ($[\text{M}+\text{H}]^+$)



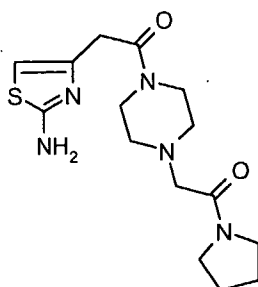
37.3 Using general procedure C, (2-tert-butoxycarbonylamino-thiazol-4-yl)-acetic acid was coupled with 1-(pyrrolidinocarbonylmethyl)piperazine to give (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-carbamic acid tert-butyl ester. White solid. MS 460.4 ($[\text{M}+\text{Na}]^+$)



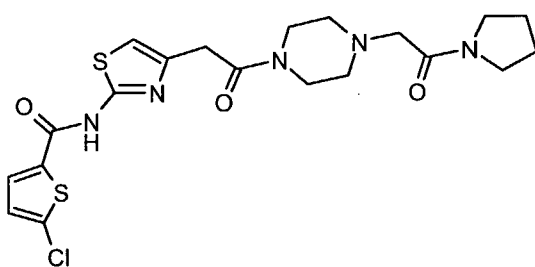
37.4 In analogy to example 33, (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-carbamic acid tert-butyl ester was deprotected

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to give 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone. Off-white amorphous solid. MS 338.3 ($[M+H]^+$)

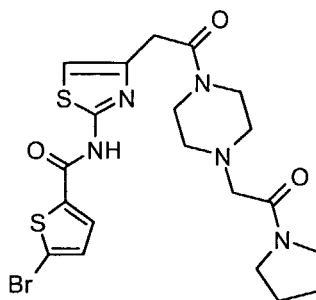


- 5 37.5 Using general procedure D, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone was coupled with 5-chlorothiophene-2-carboxylic acid to give 5-chloro-thiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Light yellow amorphous solid. MS 482.4 ($[M+H]^+$)



Example 38

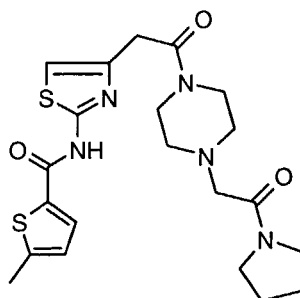
5 In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 5-bromothiophene-2-carboxylic acid, using general method D, to give 5-bromothiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Light yellow solid. MS 528.1 ($[M+H]^+$)



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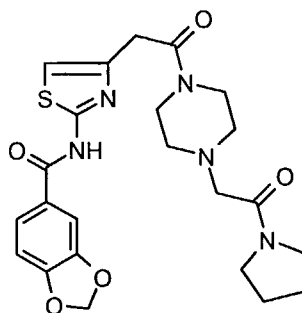
Example 39

15 In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 5-methylthiophene-2-carboxylic acid, using general method D, to give 5-methylthiophene-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Light yellow solid. MS 462.3 ($[M+H]^+$)



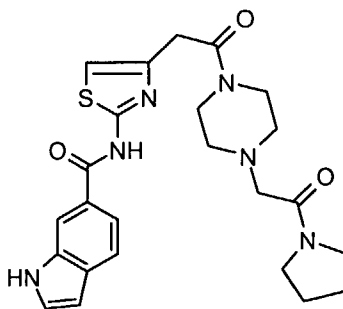
Example 40

In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with piperonylic acid, using general method D, to give benzo[1,3]dioxole-5-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Off-white solid. MS 486.4 ($[M+H]^+$)



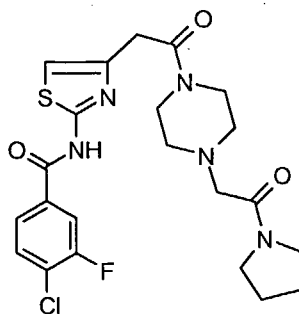
10 Example 41

In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with indole-6-carboxylic acid, using general method D, to give 1H-indole-6-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Off-white solid. MS 481.5 ($[M+H]^+$)



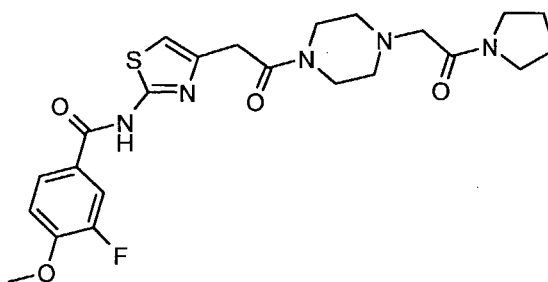
Example 42

In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 4-chloro-3-fluorocarboxylic acid, using general method D, to give 4-chloro-3-fluoro-N-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide. Off-white solid. MS 494.5 ($[M+H]^+$)



Example 43

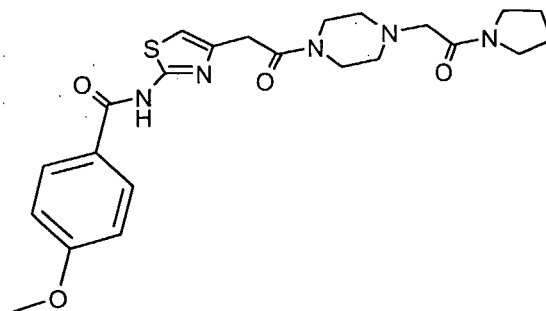
In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 3-fluoro-4-methoxycarboxylic acid, using general method D, to give 3-fluoro-4-methoxy-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide. Light yellow solid. MS 490.4 ($[M+H]^+$)



Example 44

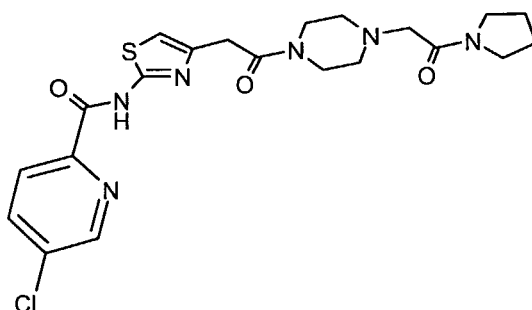
In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with p-anisic acid, using general method D, to give 4-methoxy-(4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide.

yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide. White solid. MS. 472.3
 ([M+H]⁺)



5 Example 45

In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 5-chloro-pyridine-2-carboxylic acid, using general method D, to give 5-chloro-pyridine-2-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. Yellow solid. MS 477.3 ([M+H]⁺)

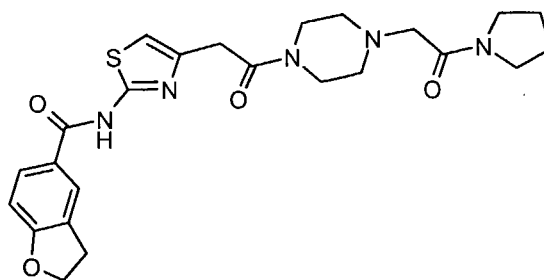


Example 46

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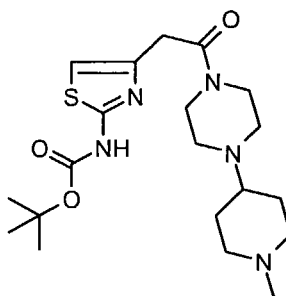
In analogy to example 37.5, 2-(2-amino-thiazol-4-yl)-1-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethanone (example 37.4) was coupled with 2,3-dihydrobenzofurane-5-carboxylic acid, using general method D, to give 2,3-dihydro-benzofuran-5-carboxylic acid (4-{2-oxo-2-[4-(2-oxo-2-pyrrolidin-1-yl-ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide.

ethyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-amide. White solid. MS 506.5
 ([M+Na]⁺)



5 Example 47

47.1 Using general method C, (2-tert-butoxycarbonylamino-thiazol-4-yl)-acetic acid (example 37.2) was coupled with 1-(N-methylpiperidin-4-yl)piperazine to give (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-carbamic acid tert-butyl ester. Off-white powder. MS 424.0 ([M+H]⁺)

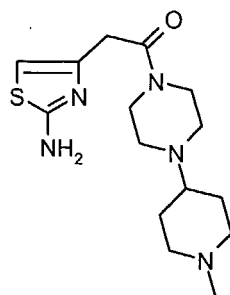


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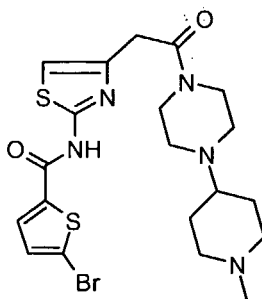
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47.2 To a stirred suspension of 3.9 g (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-carbamic acid tert-butyl ester was added 40 ml of 33 % HBr in acetic acid. The reaction mixture was stirred at r.t. for 4 h. The mixture was left overnight in the fridge. Then it was concentrated to leave an off-white solid which was suspended in 50 ml Et₂O, triturated and stirred at r.t. for 3 h. The product was collected by filtration, washed with Et₂O and dried to give 5.6 g 2-(2-amino-thiazol-4-yl)-1-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-ethanone trihydrobromide. Off-white solid. MS 324.4 ([M+H]⁺)

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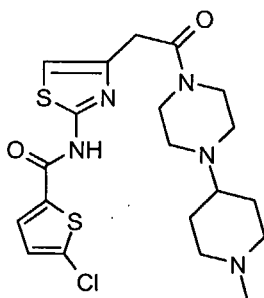


47.3 Using general procedure D, 2-(2-amino-thiazol-4-yl)-1-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-ethanone trihydrobromide was coupled with 5-bromothiophene-2-carboxylic acid to give 5-bromo-thiophene-2-carboxylic acid
5 (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide. Yellow solid. MS 514.3 ($[M+H]^+$)



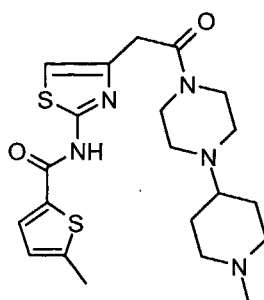
10 Example 48

In analogy to example 47.3, 2-(2-amino-thiazol-4-yl)-1-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-ethanone trihydrobromide (example 47.2) was coupled with 5-chlorothiophene-2-carboxylic acid, using general method D, to give 5-chlorothiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide. Light orange solid. MS 468.5 ($[M+H]^+$)



Example 49

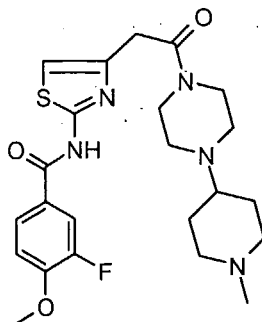
In analogy to example 47.3, 2-(2-amino-thiazol-4-yl)-1-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-ethanone trihydrobromide (example 47.2) was coupled with 5-methylthiophene-2-carboxylic acid, using general method D, to give 5-methylthiophene-2-carboxylic acid (4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide. Light yellow solid. MS 448.4 ($[M+H]^+$)



Example 50

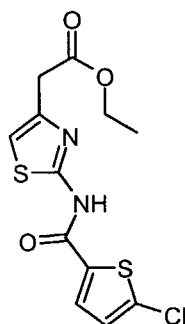
In analogy to example 47.3, 2-(2-amino-thiazol-4-yl)-1-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-ethanone trihydrobromide (example 47.2) was coupled with 3-fluoro-4-methoxybenzoic acid, using general method D, to give 3-fluoro-4-

methoxy-N-(4-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-benzamide. Off-white amorphous solid. MS 476.3 ($[M+H]^+$)



5 Example 51

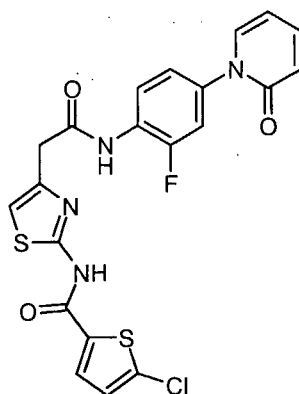
51.1 Using general method A, 5-chlorothiophene-2-carboxylic acid and ethyl-2-amino-4-thiazole acetate were coupled to give {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid ethyl ester. Off-white solid. MS 331.3 ($[M+H]^+$)



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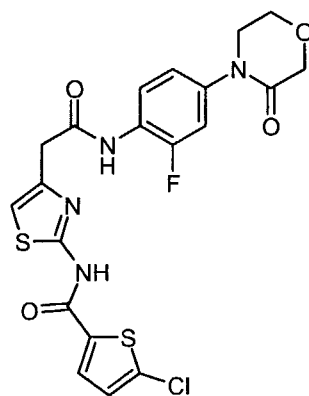
51.2 Using general method F, 5-chlorothiophene-2-carboxylic acid and ethyl-2-amino-4-thiazole acetate was reacted with 1-(4-amino-3-fluoro-phenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et *al.*, patent application WO 2003045912) to give 5-chloro-thiophene-2-carboxylic acid (4-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-thiazol-2-yl)-amide. Light yellow solid. MS 489.3 ($[M+H]^+$)

15



Example 52

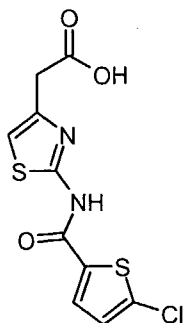
5 In analogy to example 51.2, {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid ethyl ester (example 51.1) was reacted with 4-(4-amino-3-fluorophenyl)-morpholin-3-one (CAS 742073-22-9) to give {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid ethyl ester. Light yellow solid. MS 495.4 ([M+H]⁺)



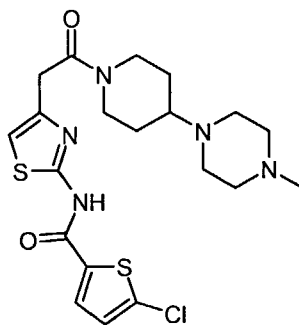
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Example 53

53.1 Using general method E, {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid ethyl ester (example 51.1) was hydrolyzed to give {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid. Off-white solid.
15 MS 301.0 ([M-H]⁻)



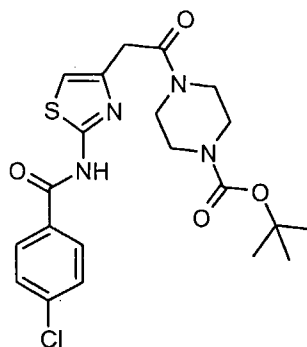
- 53.2 Using general method A, {2-[(5-chloro-thiophene-2-carbonyl)-amino]-thiazol-4-yl}-acetic acid was coupled with 1-methyl-4-(piperidin-4-yl)-piperazine to give 5-chloro-thiophene-2-carboxylic acid (4-{2-[4-(4-methyl-piperazin-1-yl)-piperidin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-amide. Light yellow amorphous solid. MS 468.4 ($[M+H]^+$)



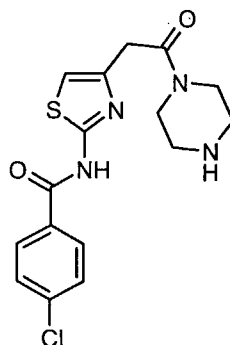
Example 54

- 54.1 Using general method A, with THF instead of DMF as solvent, [2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetic acid ethyl ester (example 1.1) was coupled with tert-butyl-1-piperazine carboxylate to give 4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazine-1-carboxylic acid tert-butyl ester. White solid. MS 465.1 ($[M+H]^+$)

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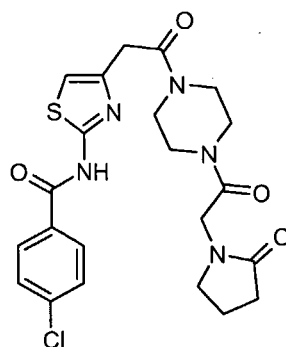


54.2 In analogy to example 33, 4-{2-[2-(4-chloro-benzoylamino)-thiazol-4-yl]-acetyl}-piperazine-1-carboxylic acid tert-butyl ester was deprotected to give 4-chloro-N-[4-(2-oxo-2-piperazin-1-yl-ethyl)-thiazol-2-yl]-benzamide. White solid.
 5 MS 365.1 ($[M+H]^+$)



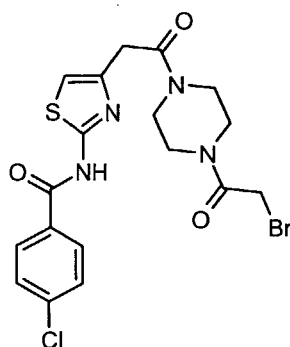
54.3 Using general procedure A, 4-chloro-N-[4-(2-oxo-2-piperazin-1-yl-ethyl)-thiazol-2-yl]-benzamide was coupled with (2-oxo-pyrrolidine-1-yl)-acetic acid (CAS 53934-76-2) to give 4-chloro-N-[4-(2-oxo-2-{4-[2-(2-oxo-pyrrolidin-1-yl)-acetyl]-piperazin-1-yl}-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 490.4 ($[M+H]^+$)
 10

- 64 -

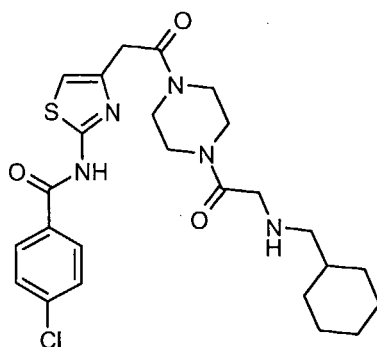


Example 55

55.1 Using general method A, with THF instead of DMF as solvent, 4-chloro-N-[4-(2-oxo-2-piperazin-1-yl-ethyl)-thiazol-2-yl]-benzamide (example 54.2) was coupled with bromoacetic acid to give N-(4-{2-[4-(2-bromo-acetyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-4-chloro-benzamide. Amorphous white solid.

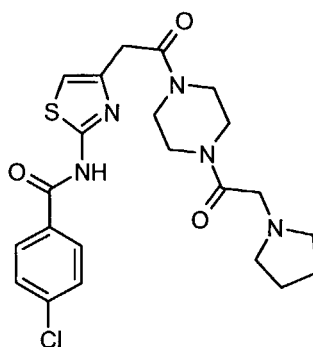


55.2 To a stirred mixture of 100 mg N-(4-{2-[4-(2-bromo-acetyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-4-chloro-benzamide in 5 ml THF at r.t. were added 0.04 ml (aminomethyl)cyclohexane and 0.09 ml triethylamine. After 48 hrs stirring at r.t. under argon atmosphere, the reaction mixture was concentrated. The crude product was purified by chromatography on silica using a gradient from CH₂Cl₂ to CH₂Cl₂/MeOH 95:5 in 20 min to give 19 mg 4-chloro-N-[4-(2-{4-[2-(cyclohexylmethyl-amino)-acetyl]-piperazin-1-yl}-2-oxo-ethyl)-thiazol-2-yl]-benzamide. White solid. MS 518.5 ([M+H]⁺)



Example 56

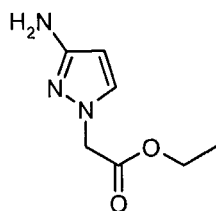
5 In analogy to example 55.2, N-(4-{2-[4-(2-bromo-acetyl)-piperazin-1-yl]-2-oxo-ethyl}-thiazol-2-yl)-4-chloro-benzamide was reacted with pyrrolidine to give 4-chloro-N-(4-{2-oxo-2-[4-(2-pyrrolidin-1-yl-acetyl)-piperazin-1-yl]-ethyl}-thiazol-2-yl)-benzamide. Off-white amorphous solid. MS 476.0 ($[M+H]^+$).



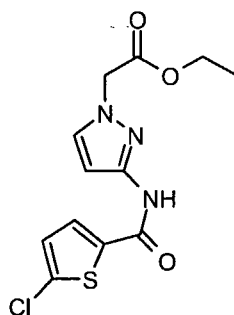
10 Example 57

57.1 To a stirred, cooled (0 °C) solution of the 1.6 g 3-aminopyrazole in DMF under an argon atmosphere was added potassium tert-butyrate. After 30 min. stirring at 0 °C, ethyl iodoacetate was added in one portion. After 2 h stirring at 0 °C, the ice bath was removed and stirring at r.t. was continued for 22 h. The mixture was concentrated in order to remove as much DMF as possible. The residue was taken up in EtOAc and washed with H₂O. The aqueous phase was extracted with EtOAc. The combined organics were washed with H₂O and brine, dried (MgSO₄), filtered and concentrated. The crude product was purified by

chromatography on silica using a gradient from cyclohexane to EtOAc in 40 min to give 366 mg (3-amino-pyrazol-1-yl)-acetic acid ethyl ester as viscous yellow oil.

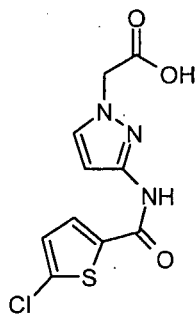


- 5 57.2 Using general method A, with THF instead of DMF as solvent, (3-amino-pyrazol-1-yl)-acetic acid ethyl ester was coupled with 5-chlorothiophene-2-carboxylic acid to give {3-[(5-chloro-thiophene-2-carbonyl)-amino]-pyrazol-1-yl}-acetic acid ethyl ester. Light yellow solid. MS 314.0 ([M+H]⁺)



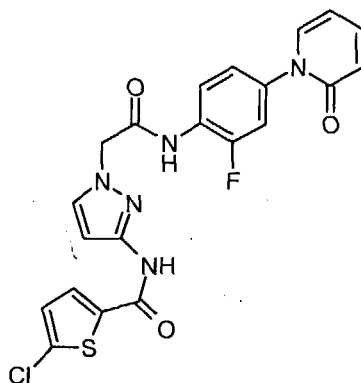
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- 57.3 Using general method E, {3-[(5-chloro-thiophene-2-carbonyl)-amino]-pyrazol-1-yl}-acetic acid ethyl ester was hydrolyzed to give {3-[(5-chloro-thiophene-2-carbonyl)-amino]-pyrazol-1-yl}-acetic acid. Off-white powder. MS 284.0 ([M-H]⁻)



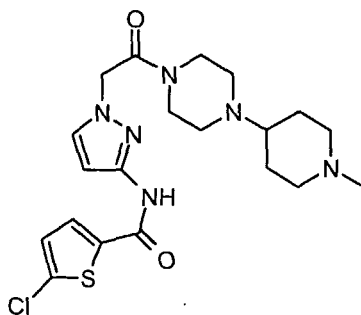
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- 57.4 According to general method B, {3-[(5-chloro-thiophene-2-carbonyl)-amino]-pyrazol-1-yl}-acetic acid was reacted with 1-(4-amino-3-fluoro-phenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et al., patent application WO 2003045912) to give 5-chloro-thiophene-2-carboxylic acid
5 (1-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl}-1H-pyrazol-3-yl)-amide. White solid. MS 472.4 ($[M+H]^+$)



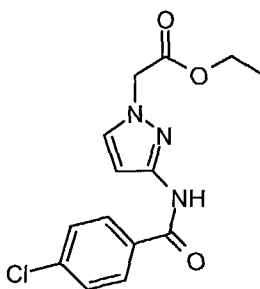
Example 58

- 10 Using general method A, using THF instead of DMF as solvent, {3-[(5-chloro-thiophene-2-carbonyl)-amino]-pyrazol-1-yl}-acetic acid (example 57.3) was reacted with 1-(N-methyl-4-piperidyl)-piperazine to give 5-chloro-thiophene-2-carboxylic acid (1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-pyrazol-3-yl)-amide. Off-white solid. MS 451.3 ($[M+H]^+$)

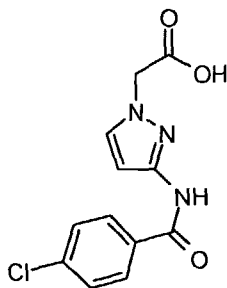


Example 59

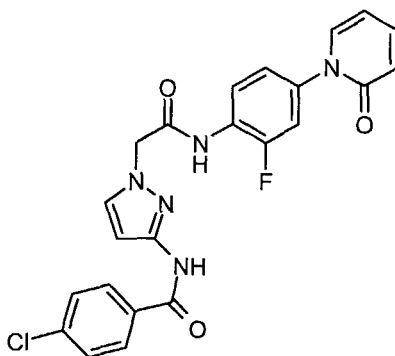
59.1 Using general method A, with THF instead of DMF as solvent, (3-amino-pyrazol-1-yl)-acetic acid ethyl ester (example 57.1) was coupled with 4-chlorobenzoic acid to give [3-(4-chloro-benzoylamino)-pyrazol-1-yl]-acetic acid ethyl ester. Off-white solid. MS 308.3 ($[M+H]^+$)



59.2 Using general method E, [3-(4-chloro-benzoylamino)-pyrazol-1-yl]-acetic acid ethyl ester was hydrolyzed to give [3-(4-chloro-benzoylamino)-pyrazol-1-yl]-acetic acid. White powder. MS 278.0 ($[M-H]^-$)

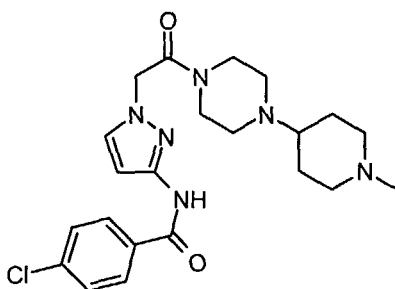


59.3 According to general method B, [3-(4-chloro-benzoylamino)-pyrazol-1-yl]-acetic acid was reacted with 1-(4-amino-3-fluoro-phenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et al., patent application WO 2003045912) to give 4-chloro-N-(1-{[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenyl]carbonyl}-methyl)-1H-pyrazol-3-yl)-benzamide. White solid. MS 466.3 ($[M+H]^+$)



Example 60

Using general method A, using THF instead of DMF as solvent, [3-(4-chloro-
5 benzoylamino)-pyrazol-1-yl]-acetic acid (example 59.2) was reacted with 1-(N-methyl-4-piperidyl)-piperazine to give 4-chloro-N-(1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-pyrazol-3-yl)-benzamide. Off-white solid. MS 445.4 ($[M+H]^+$)

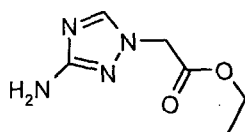


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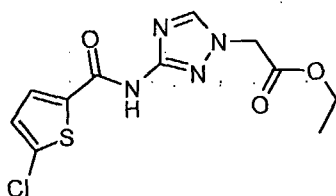
Example 61

61.1 To a stirred mixture of 2.8 g 3-amino-1,2,4-triazole in 50 ml DMF, 1.57 g NaH were slowly added at 0 °C under an argon atmosphere. After 1 hr stirring at 0 °C, 3.31 ml ethyliodoacetate were added. The reaction mixture was stirred at r.t.
15 over night. The mixture was diluted with water and extracted with EtOAc and CH₂Cl₂/MeOH 9:1. The organic phase was dried (MgSO₄), filtered and concentrated. The crude product was purified by chromatography on silica, using a gradient from CH₂Cl₂ to CH₂Cl₂/MeOH 9:1 and then crystallization from

cyclohexane/EtOAc to give 750 mg (3-amino-[1,2,4]triazol-1-yl)-acetic acid ethyl ester as a white solid.



- 5 61.2 Using general method A, (3-amino-[1,2,4]triazol-1-yl)-acetic acid ethyl ester was coupled with 5-chlorothiophene-2-carboxylic acid to give {3-[(5-chlorothiophene-2-carbonyl)-amino]-[1,2,4]triazol-1-yl}-acetic acid ethyl ester. Off-white solid. MS 315.1 ([M+H]⁺)

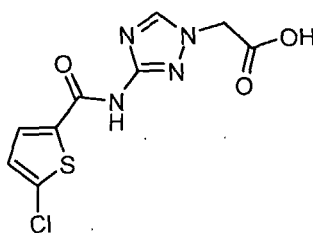


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- 61.3 Using general method E, {3-[(5-chlorothiophene-2-carbonyl)-amino]-[1,2,4]triazol-1-yl}-acetic acid ethyl ester was hydrolyzed to give {3-[(5-chlorothiophene-2-carbonyl)-amino]-[1,2,4]triazol-1-yl}-acetic acid. Off-white powder. MS

15 ([M-H]⁻)

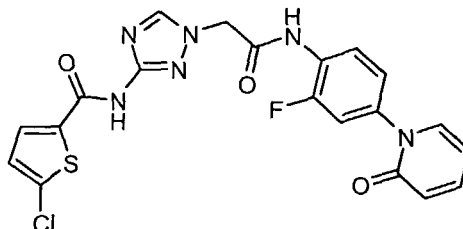
285.0



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- 61.4 According to general method B, {3-[(5-chlorothiophene-2-carbonyl)-amino]-[1,2,4]triazol-1-yl}-acetic acid was reacted with 1-(4-amino-3-fluorophenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et

al., patent application WO 2003045912) to give 5-chloro-thiophene-2-carboxylic acid (1-{{2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl}-methyl}-1H-[1,2,4]triazol-3-yl)-amide. Off-white solid. MS 473.4 ([M+H]⁺)

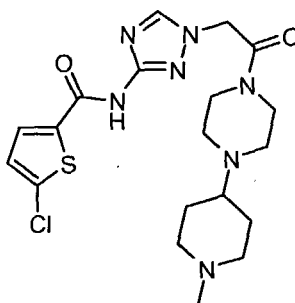


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Example 62

Using general method A, using THF instead of DMF as solvent, 3-[(5-chloro-thiophene-2-carbonyl)-amino]-[1,2,4]triazol-1-yl]-acetic acid (example 61.3) was reacted with 1-(N-methyl-4-piperidyl)-piperazine to give 5-chloro-thiophene-2-carboxylic acid (1-{2-[4-(1-methyl-piperidin-4-yl)-piperazin-1-yl]-2-oxo-ethyl}-1H-[1,2,4]triazol-3-yl)-amide. Off-white solid. MS 452.3 ([M+H]⁺)

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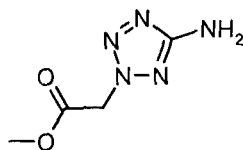
Example 63

63.1 A solution of 8.5 g 5-amino-1H-tetrazole, 8.8 ml methyl chloroacetate and 5.8 g potassium hydroxide in 100 ml methanol was heated to reflux under an argon atmosphere and stirred for 18 h. A white solid slowly precipitated. The suspension was cooled to r.t.. The white solid was filtered off and washed with methanol. The filtrate was concentrated. The residue was suspended in 100 ml EtOH and heated to reflux. After 1 h stirring at reflux, the mixture was filtered while hot. The filtrate

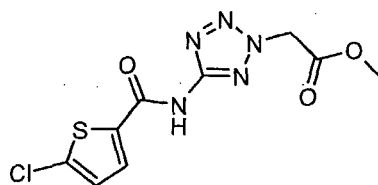
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was concentrated. The residue was recrystallized in 100 ml EtOH to give 1.8 g of (5-amino-tetrazol-2-yl)-acetic acid methyl ester as colorless crystalline solid.

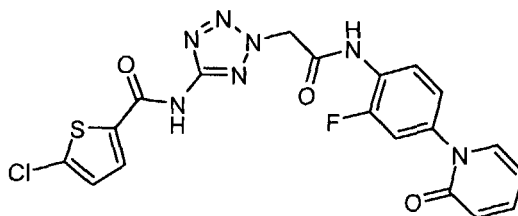


- 5 63.2 Using general method D, (5-amino-tetrazol-2-yl)-acetic acid methyl ester was coupled with 5-chlorothiophene-2-carboxylic acid to give {5-[(5-chloro-thiophene-2-carbonyl)-amino]-tetrazol-2-yl}-acetic acid methyl ester. White solid. MS 302.0 ($[M+H]^+$).



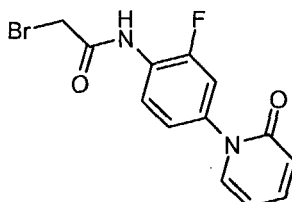
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- 63.3 Using general method F, {5-[(5-chloro-thiophene-2-carbonyl)-amino]-tetrazol-2-yl}-acetic acid methyl ester was reacted with 1-(4-amino-3-fluorophenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge et al., patent application WO 2003045912) to give 5-chloro-thiophene-2-carboxylic acid
15 (2-[[2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenyl]carbonyl]-methyl}-2H-tetrazol-5-yl)-amide. Off-white solid. MS 474.3 ($[M+H]^+$)

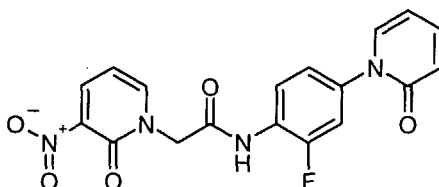


Example 64

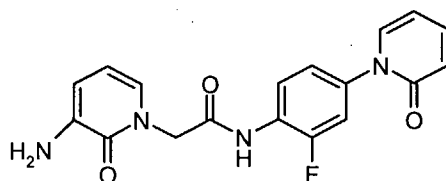
64.1 A solution of 1-(4-amino-3-fluoro-phenyl)-1H-pyridin-2-one (CAS 536747-52-1, prepared according to C. F. Bigge *et al.*, patent application WO 2003045912) in 150 ml THF was treated with 5.8 ml triethylamine and 3.2 ml bromoacetyl bromide. The reaction mixture was stirred overnight at r.t., then again treated with 2.1 ml bromoacetyl bromide. After stirring overnight at r.t., the solid was filtered off and washed with THF. Then it was dissolved in EtOAc and washed 2x with 100ml H₂O. The organic layer was dried over MgSO₄, filtered and concentrated to give 3.0 g 2-bromo-[2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-acetamide as off-white solid. MS 325.1 ([M+H]⁺)



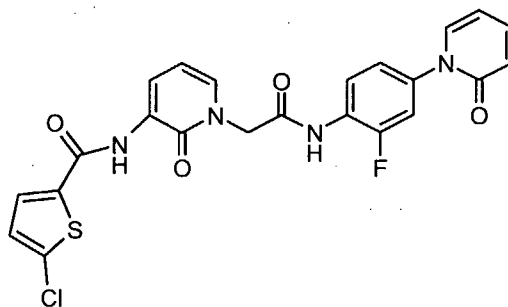
64.2 A suspension of 34 mg sodium hydride in 2 ml DMF was cooled to 0 °C and treated portionwise with 100 mg of 2-hydroxy-3-nitropyridine. The reaction mixture was stirred for 30 min, then treated at 0 °C with 0.244 mg 2-bromo-[2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-acetamide. The reaction mixture was stirred over night at r.t., then diluted with EtOAc and washed with water. The organic layer was dried (MgSO₄), filtered and concentrated. The crude product was purified by chromatography (silica gel, gradient CH₂Cl₂ -> CH₂Cl₂/MeOH 95:5) to give 61 mg [2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-2-(3-nitro-2-oxo-pyridin-1-yl)-acetamide as a light yellow solid. MS 385.1 ([M+H]⁺)



- 64.3 A suspension of 60 mg [2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-2-(3-nitro-2-oxo-pyridin-1-yl)-acetamide in 1 ml acetic acid was treated portionwise with 82 mg activated zinc powder. The reaction mixture was stirred for 3 hrs at r.t. The solid was filtered off and washed carefully with EtOH. The filtrate was concentrated. The crude product was purified by chromatography (silica, gradient $\text{CH}_2\text{Cl}_2 \rightarrow \text{CH}_2\text{Cl}_2/\text{MeOH}$ 95:5) to give 39 mg 2-(3-amino-2-oxo-pyridin-1-yl)-[2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-acetamide as off-white solid. MS 355.0 ($[\text{M}+\text{H}]^+$)



- 64.4 Using general method A, 2-(3-amino-2-oxo-pyridin-1-yl)-[2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-acetamide was reacted with 5-chloro-thiophene-2-carboxylic acid to give 5-chloro-thiophene-2-carboxylic acid (1-[[2-fluoro-4-(2-oxo-pyridin-1-yl)-phenyl]-carbamoyl]-methyl)-2-oxo-1,2-dihydro-pyridin-3-yl)-amide. Off-white solid. MS 499.3 ($[\text{M}+\text{H}]^+$)



Example A

Film coated tablets containing the following ingredients can be manufactured in a conventional manner:

<u>Ingredients</u>		Per	
tablet			
Kernel:			
Compound of formula (I) cellulose glycolate <			

- 5 The active ingredient is sieved and mixed with microcristalline cellulose and the mixture is granulated with a solution of polyvinylpyrrolidon in water. The

granulate is mixed with sodium starch glycolate and magnesium stearate and compressed to yield kernels of 120 or 350 mg respectively. The kernels are lacquered with an aqueous solution / suspension of the above mentioned film coat.

Example B

- 5 Capsules containing the following ingredients can be manufactured in a conventional manner:

<u>Ingredients</u>	<u>Per capsule</u>
Compound of formula (I)	25.0 mg
Lactose	150.0 mg
Maize starch	20.0 mg
Talc	5.0 mg

The components are sieved and mixed and filled into capsules of size 2.

Example C

- 10 Injection solutions can have the following composition:

Compound of formula (I)	3.0 mg
Polyethylene Glycol 400	150.0 mg
Acetic Acid	q.s. ad pH 5.0
Water for injection solutions	ad 1.0 ml

- 15 The active ingredient is dissolved in a mixture of Polyethylene Glycol 400 and water for injection (part). The pH is adjusted to 5.0 by Acetic Acid. The volume is adjusted to 1.0 ml by addition of the residual amount of water. The solution is filtered, filled into vials using an appropriate overage and sterilized.

Example D

Soft gelatin capsules containing the following ingredients can be manufactured in a conventional manner:

Capsule contents

Compound of formula (I)	5.0 mg
Yellow wax	8.0 mg
Hydrogenated Soya bean oil	8.0 mg
Partially hydrogenated plant oils	34.0 mg
Soya bean oil	110.0 mg
Weight of capsule contents	165.0 mg
Gelatin capsule	
Gelatin	75.0 mg
Glycerol 85 %	32.0 mg
Karion 83	8.0 mg (dry matter)
Titan dioxide	0.4 mg
Iron oxide yellow	1.1 mg

- 5 The active ingredient is dissolved in a warm melting of the other ingredients and the mixture is filled into soft gelatin capsules of appropriate size. The filled soft gelatin capsules are treated according to the usual procedures.

Example E

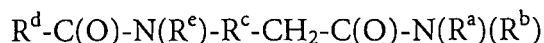
Sachets containing the following ingredients can be manufactured in a conventional manner:

Compound of formula (I)	50.0 mg
Lactose, fine powder	1015.0 mg
Microcrystalline cellulose (AVICEL PH 102)	1400.0 mg
Sodium carboxymethyl cellulose	14.0 mg
Polyvinylpyrrolidon K 30	10.0 mg
Magnesiumstearate	10.0 mg
Flavoring additives	1.0 mg

- 5 The active ingredient is mixed with lactose, microcrystalline cellulose and sodium carboxymethyl cellulose and granulated with a mixture of polyvinylpyrrolidon in water. The granulate is mixed with magnesiumstearate and the flavouring additives and filled into sachets.

Claims:

1. Compounds of formula (I)



(I)

5 wherein

R^a is hydrogen or C_{1-6} alkyl;

R^b is $R^{b1}-R^{b2}$, wherein

10 R^{b1} is aryl or heteroaryl, said aryl and heteroaryl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkyl and halogen, and

15 R^{b2} is aryl, heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} alkoxy, halogen, cyano, nitro, amino, mono- or di- C_{1-6} alkyl substituted amino, hydroxy, hydroxy C_{1-6} alkyl, aminocarbonyl, mono- or di- C_{1-6} alkyl substituted aminocarbonyl, halo C_{1-6} alkyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylsulfinyl, C_{1-6} alkylthio, amino C_{1-6} alkyl, mono- or di- C_{1-6} alkyl substituted amino C_{1-6} alkyl, aminosulfonyl and mono- or di- C_{1-6} alkyl substituted amino sulfonyl, 20 and one or two carbon atoms of said aryl, heteroaryl and heterocyclyl being optionally replaced with a carbonyl group; or

R^a and R^b , together with the nitrogen atom to which they are attached, form heterocyclyl-A- R^{b3} , wherein said heterocyclyl is optionally substituted by halogen or C_{1-6} alkyl, and

25 A is a bond, -O- or C_{1-6} alkylene wherein one $-CH_2-$ is optionally replaced with a carbonyl group, and/or another $-CH_2-$ is optionally replaced with $-NR^f$, and

R^{b3} is amino optionally mono- or di-substituted by a substituent independently selected from the group consisting of C₁₋₆ alkyl, C₂₋₆ alkenyl and C₂₋₆ alkynyl, or

5 R^{b3} is aryl, heteroaryl, C₃₋₇ cycloalkyl or heterocyclyl, said aryl, heteroaryl, C₃₋₇ cycloalkyl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₁₋₆ alkoxy, halogen, cyano, nitro, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted
10 aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, amino C₁₋₆ alkyl, mono- or di-C₁₋₆ alkyl substituted amino C₁₋₆ alkyl, aminosulfonyl and mono- or di-C₁₋₆ alkyl substituted amino sulfonyl, and one or two carbon atoms of said aryl, heteroaryl, C₃₋₇ cycloalkyl and heterocyclyl being optionally replaced with a carbonyl
15 group;

R^c is heteroaryl optionally substituted by one or more substituents independently selected from the group consisting of halogen and C₁₋₆ alkyl and one or two carbon atoms of said heteroaryl being optionally replaced with a carbonyl group;

20 R^d is aryl, heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl optionally being substituted by one or more substituents independently selected from the group consisting of halogen, C₁₋₆ alkyl and C₁₋₆ alkoxy, and the aryl may be fused to a heterocyclyl ring;

R^e is hydrogen or C₁₋₆ alkyl;

25 R^f is hydrogen or C₁₋₆ alkyl;

and prodrugs and pharmaceutically acceptable salts thereof;

wherein

the term "aryl" means a phenyl or a naphthyl group;

the term "heterocyclyl" means non-aromatic mono- or bi-cyclic radicals of
30 three to eight ring atoms in which one or two ring atoms are heteroatoms

selected from N, O, or S(O)_n (where n is an integer from 0 to 2), the remaining ring atoms being C;

the term "heteroaryl" means a monocyclic or bicyclic radical of 5 to 12 ring atoms having at least one aromatic ring containing one, two, or three ring heteroatoms selected from N, O, and S, the remaining ring atoms being C, with the understanding that the attachment point of the heteroaryl radical will be on an aromatic ring.

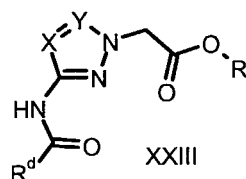
2. The compounds according to claim 1, wherein R^a and R^b, together with the nitrogen atom to which they are attached, form heterocyclyl-A-R^{b3}, wherein said heterocyclyl is optionally substituted by halogen or C₁₋₆ alkyl, and A and R^{b3} are as defined in claim 1.
3. The compounds according to claim 2, wherein the heterocyclyl-A-R^{b3} is piperazin-1-yl or piperidin-1-yl, said piperazin-1-yl or piperidin-1-yl being bonded to -A-R^{b3} at 4-position.
4. The compounds according to any one of claims 2 to 3, wherein A is a bond or -CH₂-C(O)-.
5. The compounds according to any one of claims 2 to 4, wherein R^{b3} is heterocyclyl optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₁₋₆ alkoxy, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, and one or two carbon atoms of said heterocyclyl being optionally replaced with a carbonyl group.
6. The compounds according to any one of claims 2 to 5, wherein R^{b3} is piperidinyl, pyrrolidinyl, morpholinyl, piperazinyl or thiazolidinyl, said heterocyclyls being optionally substituted by one or more substituents independently selected from the group consisting of C₁₋₆ alkyl, C₁₋₆ alkoxy, amino, mono- or di-C₁₋₆ alkyl substituted amino, hydroxy, hydroxy C₁₋₆ alkyl, aminocarbonyl, mono- or di-C₁₋₆ alkyl substituted aminocarbonyl, halo C₁₋₆ alkyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylsulfinyl, C₁₋₆ alkylthio, and one or two

carbon atoms of said heterocyclyls being optionally replaced with a carbonyl group.

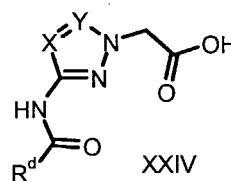
7. The compounds according to claim 1, wherein R^a is hydrogen or C_{1-6} alkyl, and R^b is $R^{b1}-R^{b2}$, wherein R^{b1} and R^{b2} are as defined in claim 1.
- 5 8. The compounds according to claim 7, wherein R^a is hydrogen.
9. The compounds according to any one of claims 7 and 8, wherein R^{b1} is phenyl optionally substituted by one or more same or different halogen atoms.
- 10 10. The compounds according to any one of claims 7 and 9, wherein R^{b1} is fluorophenyl.
11. The compounds according to any one of claims 7 to 10, wherein R^{b2} is aryl, heteroaryl or heterocyclyl, said aryl, heteroaryl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkylsulfonyl, C_{1-6} alkylsulfinyl, C_{1-6} alkylthio, amino C_{1-6} alkyl, mono- or di- C_{1-6} alkyl substituted amino C_{1-6} alkyl, aminosulfonyl and mono- or di- C_{1-6} alkyl substituted amino sulfonyl, and one or two carbon atoms of said aryl, heteroaryl and heterocyclyl being optionally replaced with a carbonyl group.
- 15 12. The compounds according to any one of claims 7 to 11, wherein R^{b2} is heteroaryl or heterocyclyl having a ring member nitrogen atom bonded to R^{b1} , said heteroaryl and heterocyclyl being optionally substituted by one or more substituents independently selected from the group consisting of C_{1-6} alkylsulfonyl, C_{1-6} alkylsulfinyl, C_{1-6} alkylthio, amino C_{1-6} alkyl, mono- or di- C_{1-6} alkyl substituted amino C_{1-6} alkyl, aminosulfonyl and mono- or di- C_{1-6} alkyl substituted amino sulfonyl, and one or two carbon atoms of said heteroaryl and heterocyclyl being optionally replaced with a carbonyl group.
- 20 13. The compounds according to any one of claims 1 to 12, wherein R^c is hydrogen.
- 25 14. The compounds according to any one of claims 1 to 13, wherein R^c is thiazolyl, pyrazolyl, triazolyl, tetrazolyl or pyridonyl.
- 30

15. The compounds according to any one of claims 1 to 14, wherein R^d is phenyl or thienyl, said phenyl and thienyl optionally being substituted by one or more substituents independently selected from the group consisting of halogen, C_{1-6} alkyl and C_{1-6} alkoxy.
- 5 16. The compounds according to any one of claims 1 to 15, wherein R^d is chlorophenyl or chlorothiényl.
17. The compound according to claim 1, which is 5-chloro-thiophene-2-carboxylic acid (1-([2-fluoro-4-(2-oxo-2H-pyridin-1-yl)-phenylcarbamoyl]-methyl)-1H-[1,2,4]triazol-3-yl)-amide.
- 10 18. A process for the manufacture of compounds of formula (I) according to claim 1, comprising

i-a) converting compound XXIII

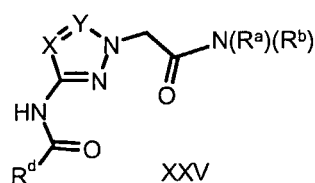


to compound XXIV



by saponification, and

i-b) coupling compound XXIV with an amine $HN(R^a)(R^b)$ to obtain compound XXV



or

ii) reacting compound XXIII with an aniline $\text{HN}(\text{R}^a)(\text{R}^b)$ to obtain compound XXV,

wherein both X and Y are CH or both X and Y are N or X is N and Y is CH, R' is methyl or ethyl and R^a , R^b and R^d are as defined in claim 1.

- 5
19. Compounds according to any of claims 1 - 17, when manufactured by a process according to claim 18.
20. Pharmaceutical compositions comprising a compound according to any of claims 1-17 and a pharmaceutically acceptable excipient.
- 10
21. The compounds according to any of claims 1-17 for use as therapeutic active substances.
22. The compounds according to any of claims 1-17 for use as therapeutic active substances for the treatment and/or prophylaxis of diseases which are associated with the coagulation factor Xa.
- 15
23. Use of compounds according to any of claims 1-17 for the preparation of medicaments for the therapeutic and/or prophylactic treatment of diseases which are associated with the coagulation factor Xa.
- 20
24. The use according to claim 23, wherein the disease is thrombotic disorders, arterial thrombosis, venous thrombosis, deep vein thrombosis, peripheral arterial occlusive disease, unstable angina pectoris, myocardial infarction, coronary artery disease, pulmonary embolism, stroke due to atrial fibrillation, inflammation, arteriosclerosis, acute vessel closure associated with thrombolytic therapy or restenosis, and/or tumour.
- 25
25. The invention as hereinbefore defined, particularly with reference to the new compounds, intermediates, medicaments, uses and processes.