

Benzothiazolone derivatives

BACKGROUND OF THE INVENTION

The invention had the object of finding novel compounds having valuable properties, in particular those which can be used for the preparation of medicaments.

The present invention relates to compounds and to the use of compounds in which the inhibition, regulation and/or modulation of signal transduction by kinases, in particular tyrosine kinases and/or serine/threonine kinases, plays a role, furthermore to pharmaceutical compositions which comprise these compounds, and to the use of the compounds for the treatment of kinase-induced diseases.

In particular, the present invention relates to compounds and to the use of compounds in which the inhibition, regulation and/or modulation of signal transduction by Met kinase plays a role.

One of the principal mechanisms by which cellular regulation is effected is through the transduction of extracellular signals across the membrane that in turn modulate biochemical pathways within the cell. Protein phosphorylation represents one course by which intracellular signals are propagated from molecule to molecule resulting finally in a cellular response. These signal transduction cascades are highly regulated and often overlap, as is evident from the existence of many protein kinases as well as phosphatases. Phosphorylation of proteins occurs predominantly at serine, threonine or tyrosine residues, and protein kinases have therefore been classified by their specificity of phosphorylation site, i.e. serine/threonine kinases and tyrosine kinases. Since phosphorylation is such a ubiquitous process within cells and since cellular phenotypes are largely influenced by the activity of these pathways, it is currently believed that a number of disease

states and/or diseases are attributable to either aberrant activation or functional mutations in the molecular components of kinase cascades. Consequently, considerable attention has been devoted to the characterisation of these proteins and compounds that are able to modulate their activity (for
5 a review see: Weinstein-Oppenheimer et al. *Pharma. & Therap.*, 2000, 88, 229-279).

The role of the receptor tyrosine kinase Met in human oncogenesis and the possibility of inhibition of HGF (hepatocyte growth factor)dependent Met activation are described by S. Berthou et al. in *Oncogene*, Vol. 23, No. 31, pages 5387-5393 (2004). The inhibitor SU11274 described therein, a pyrrole-indoline compound, is potentially suitable for combating
10 cancer.

Another Met kinase inhibitor for cancer therapy is described by J.G. Christensen et al. in *Cancer Res.* 2003, 63(21), 7345-55.

A further tyrosine kinase inhibitor for combating cancer is reported by H. Hov et al. in *Clinical Cancer Research* Vol. 10, 6686-6694 (2004). The
20 compound PHA-665752, an indole derivative, is directed against the HGF receptor c-Met. It is furthermore reported therein that HGF and Met make a considerable contribution to the malignant process of various forms of cancer, such as, for example, multiple myeloma.

The synthesis of small compounds which specifically inhibit, regulate and/or modulate signal transduction by tyrosine kinases and/or serine/threonine kinases, in particular Met kinase, is therefore desirable and an
30 aim of the present invention.

It has been found that the compounds according to the invention and salts thereof have very valuable pharmacological properties while being well tolerated.
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The present invention specifically relates to compounds of the formula I which inhibit, regulate and/or modulate signal transduction by Met kinase, to compositions which comprise these compounds, and to processes for the use thereof for the treatment of Met kinase-induced diseases and complaints, such as angiogenesis, cancer, tumour formation, growth and propagation, arteriosclerosis, ocular diseases, such as age-induced macular degeneration, choroidal neovascularisation and diabetic retinopathy, inflammatory diseases, arthritis, thrombosis, fibrosis, glomerulonephritis, neurodegeneration, psoriasis, restenosis, wound healing, transplant rejection, metabolic diseases and diseases of the immune system, also autoimmune diseases, cirrhosis, diabetes and diseases of the blood vessels, also instability and permeability and the like in mammals.

Solid tumours, in particular fast-growing tumours, can be treated with Met kinase inhibitors. These solid tumours include monocytic leukaemia, brain, urogenital, lymphatic system, stomach, laryngeal and lung carcinoma, including lung adenocarcinoma and small-cell lung carcinoma.

The present invention is directed to processes for the regulation, modulation or inhibition of Met kinase for the prevention and/or treatment of diseases in connection with unregulated or disturbed Met kinase activity. In particular, the compounds of the formula I can also be employed in the treatment of certain forms of cancer. The compounds of the formula I can furthermore be used to provide additive or synergistic effects in certain existing cancer chemotherapies, and/or can be used to restore the efficacy of certain existing cancer chemotherapies and radiotherapies.

The compounds of the formula I can furthermore be used for the isolation and investigation of the activity or expression of Met kinase. In addition, they are particularly suitable for use in diagnostic methods for diseases in connection with unregulated or disturbed Met kinase activity.

It can be shown that the compounds according to the invention have an antiproliferative action in vivo in a xenotransplant tumour model. The compounds according to the invention are administered to a patient having a hyperproliferative disease, for example to inhibit tumour growth, to reduce inflammation associated with a lymphoproliferative disease, to inhibit transplant rejection or neurological damage due to tissue repair, etc. The present compounds are suitable for prophylactic or therapeutic purposes. As used herein, the term "treatment" is used to refer to both prevention of diseases and treatment of pre-existing conditions. The prevention of proliferation is achieved by administration of the compounds according to the invention prior to the development of overt disease, for example to prevent the growth of tumours, prevent metastatic growth, diminish restenosis associated with cardiovascular surgery, etc. Alternatively, the compounds are used for the treatment of ongoing diseases by stabilising or improving the clinical symptoms of the patient.

The host or patient can belong to any mammalian species, for example a primate species, particularly humans; rodents, including mice, rats and hamsters; rabbits; horses, cows, dogs, cats, etc. Animal models are of interest for experimental investigations, providing a model for treatment of human disease.

The susceptibility of a particular cell to treatment with the compounds according to the invention can be determined by in vitro tests. Typically, a culture of the cell is combined with a compound according to the invention at various concentrations for a period of time which is sufficient to allow the active agents to induce cell death or to inhibit migration, usually between about one hour and one week. In vitro testing can be carried out using cultivated cells from a biopsy sample. The viable cells remaining after the treatment are then counted.

The dose varies depending on the specific compound used, the specific disease, the patient status, etc. A therapeutic dose is typically sufficient

considerably to reduce the undesired cell population in the target tissue while the viability of the patient is maintained. The treatment is generally continued until a considerable reduction has occurred, for example an at least about 50% reduction in the cell burden, and may be continued until essentially no more undesired cells are detected in the body.

For identification of a signal transduction pathway and for detection of interactions between various signal transduction pathways, various scientists have developed suitable models or model systems, for example cell culture models (for example Khwaja et al., EMBO, 1997, 16, 2783-93) and models of transgenic animals (for example White et al., Oncogene, 2001, 20, 7064-7072). For the determination of certain stages in the signal transduction cascade, interacting compounds can be utilised in order to modulate the signal (for example Stephens et al., Biochemical J., 2000, 351, 95-105). The compounds according to the invention can also be used as reagents for testing kinase-dependent signal transduction pathways in animals and/or cell culture models or in the clinical diseases mentioned in this application.

Measurement of the kinase activity is a technique which is well known to the person skilled in the art. Generic test systems for the determination of the kinase activity using substrates, for example histone (for example Alessi et al., FEBS Lett. 1996, 399, 3, pages 333-338) or the basic myelin protein, are described in the literature (for example Campos-González, R. and Glenney, Jr., J.R. 1992, J. Biol. Chem. 267, page 14535).

For the identification of kinase inhibitors, various assay systems are available. In scintillation proximity assay (Sorg et al., J. of Biomolecular Screening, 2002, 7, 11-19) and flashplate assay, the radioactive phosphorylation of a protein or peptide as substrate with γ ATP is measured. In the presence of an inhibitory compound, a decreased radioactive signal, or none at

all, is detectable. Furthermore, homogeneous time-resolved fluorescence resonance energy transfer (HTR-FRET) and fluorescence polarisation (FP) technologies are suitable as assay methods (Sills et al., J. of Biomolecular Screening, 2002, 191-214).

Other non-radioactive ELISA assay methods use specific phospho-antibodies (phospho-ABs). The phospho-AB binds only the phosphorylated substrate. This binding can be detected by chemiluminescence using a second peroxidase-conjugated anti-sheep antibody (Ross et al., 2002, Biochem. J.).

There are many diseases associated with deregulation of cellular proliferation and cell death (apoptosis). The conditions of interest include, but are not limited to, the following. The compounds according to the invention are suitable for the treatment of various conditions where there is proliferation and/or migration of smooth muscle cells and/or inflammatory cells into the intimal layer of a vessel, resulting in restricted blood flow through that vessel, for example in the case of neointimal occlusive lesions. Occlusive graft vascular diseases of interest include atherosclerosis, coronary vascular disease after grafting, vein graft stenosis, peri-anastomatic prosthetic restenosis, restenosis after angioplasty or stent placement, and the like.

PRIOR ART REGARDING MET KINASE INHIBITORS

Thiadiazinones are disclosed in WO 03/037349

4,5-Dihydropyrazoles for combating cancer are known from WO 03/079973 A2.

Quinoline derivatives are described in EP 1 411 046 A1.

Pyrrole-indoline derivatives are disclosed in WO 02/096361 A2.

1-Acyldihydropyrazole derivatives are known from WO 2007/019933.

Pyridazinone derivatives are described in WO 2006/010668.

Substituted 5-phenyl-3,6-dihydro-2-oxo-6*H*-1,3,4-thiadiazines are known from WO 2006/010285.

3,6-Dihydro-2-oxo-6*H*-1,3,4-thiadiazine derivatives are described in WO 2006/010286.

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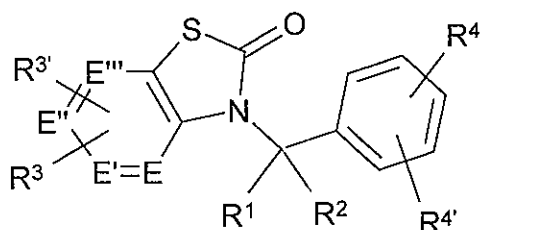
In addition, other Met kinase inhibitors are known from WO 2005/004607, WO 2005/030140, WO 2006/014325, WO 2006/021881 and WO 2006/021881.

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SUMMARY OF THE INVENTION

The invention relates to compounds of the formula I

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in which

E, E', E'', E''' each, independently of one another, denote C or N,

R¹, R² each, independently of one another, denote H or A,

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R¹ and R² together also denote (CH₂)_p, in which 1 or 2 CH₂ group(s) may be replaced by O and/or NH,

R³ denotes H, Ar, (CH₂)_nCONH₂, (CH₂)_nCONHA, (CH₂)_nCONAA', A, COA, OH, OA, CONH(CH₂)_mNH₂, CONH(CH₂)_mNHA,

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CONH(CH₂)_mNAA', CO(CH₂)_mNH₂, CO(CH₂)_mNHA, CO(CH₂)_mNAA', CO(CH₂)_mHet, CH(OH)A, CN, (CH₂)_nHet, Hal, CONH(CH₂)_mNA-COOA, SO₂A, NH(CH₂)_mNH₂, NH(CH₂)_mNHA, NH(CH₂)_mNAA', (CH₂)_nCOOH, (CH₂)_nCOOA, O(CH₂)_mNH₂, O(CH₂)_mNHA, O(CH₂)_mNAA', OHet, N=CH-NAA', N=CH-NHA,

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N=CH-NH₂, O(CH₂)_mHet,

- $N(R^6)_2$, NR^6COA , NR^6SO_2A , $SO_2N(R^6)_2$, $[C(R^6)_2]_nN(R^6)_2$,
 $S[C(R^6)_2]_pN(R^6)_2$, $S[C(R^6)_2]_nHet$, $-NR^6[C(R^6)_2]_nHet$, $NHCON(R^6)_2$,
 $NHCONH[C(R^6)_2]_pN(R^6)_2$, $NHCONH[C(R^6)_2]_nHet$, $NHCO[C(R^6)_2]_p-$
 $N(R^6)_2$, $NHCO[C(R^6)_2]_nHet$, $CONR^6[C(R^6)_2]_nHet$, $COHet$,
 $O[C(R^6)_2]_pNR^6COZ$, $O[C(R^6)_2]_pNR^2COHet^1$,
 $O[C(R^6)_2]_nCyc[C(R^6)_2]_nN(R^6)_2$,
 $O[C(R^6)_2]_nCyc[C(R^6)_2]_nOR^6$, $O[C(R^6)_2]_nCyc[C(R^6)_2]_nHet^1$,
 $CH_2-(CH_2)_q$
 $O[C(R^6)_2]_n-\overset{\diagup}{\underset{\diagdown}{C}}-[C(R^6)_2]_nN(R^6)_2$,
 $CH_2-(CH_2)_q$
 $O[C(R^6)_2]_n-\overset{\diagup}{\underset{\diagdown}{C}}-[C(R^6)_2]_nOR^6$,
 $CH_2-(CH_2)_q$
 $O[C(R^6)_2]_n-\overset{\diagup}{\underset{\diagdown}{C}}-[C(R^6)_2]_nHet$,
 $O[C(R^6)_2]_nCR^6(NR^6)_2COOR^6$,
 $O[C(R^6)_2]_nNR^6CO[C(R^6)_2]_nNR^6COA$, $O[C(R^6)_2]_pNR^6COOA$,
 $O[C(R^6)_2]_nCO-NR^6-A$,
 $O[C(R^6)_2]_nCO-NR^6-[C(R^6)_2]_nHet^1$, $O[C(R^6)_2]_nCONH_2$,
 $O[C(R^6)_2]_nCONHA$, $O[C(R^6)_2]_nCONA_2$,
 $O[C(R^6)_2]_nCO-NR^6-[C(R^2)_2]_nN(R^6)_2$ or $OCOA$,
 Z denotes $CR^6(NR^6)_2CR^6(OR^6)A$,
 $R^{3'}$ denotes H or Hal,
 R^4 denotes Het^1 , $NHCOOR^5$, $NHCONHR^5$, $NHCOCONHR^5$, NO_2 or
 $NHCOA$,
 $R^{4'}$ denotes H or Hal,
 R^4 and $R^{4'}$ together also denote $NHCONH$,
 R^5 denotes A, $(CH_2)_mNH_2$, $(CH_2)_mNHA$, $(CH_2)_mNAA'$ or $(CH_2)_mHet$,
Ar denotes phenyl, naphthyl or biphenyl, each of which is unsubsti-
tuted or mono-, di- or trisubstituted by Hal, A, OH, OA, $N(R^6)_2$,
 SR^6 , NO_2 , CN, $COOR^6$, $CON(R^6)_2$, NR^6COA , NR^6SO_2A ,

- 5 $\text{SO}_2\text{N}(\text{R}^6)_2$, $\text{S}(\text{O})_m\text{A}$, CO-Het^1 , $[\text{C}(\text{R}^6)_2]_n\text{N}(\text{R}^6)_2$, $[\text{C}(\text{R}^6)_2]_n\text{Het}^1$,
 $\text{O}[\text{C}(\text{R}^6)_2]_p\text{N}(\text{R}^6)_2$, $\text{O}[\text{C}(\text{R}^6)_2]_n\text{Het}^1$, NHCOOA , $\text{NHCON}(\text{R}^6)_2$,
 $\text{NHCOO}[\text{C}(\text{R}^6)_2]_p\text{N}(\text{R}^6)_2$, $\text{NHCOO}[\text{C}(\text{R}^6)_2]_n\text{Het}^1$, $\text{NHCONH}[\text{C}(\text{R}^6)_2]_p$ -
 $\text{N}(\text{R}^3)_2$, $\text{NHCONH}[\text{C}(\text{R}^6)_2]_n\text{Het}^1$, $\text{OCONH}[\text{C}(\text{R}^6)_2]_p\text{N}(\text{R}^6)_2$ and/or
 $\text{OCONH}[\text{C}(\text{R}^6)_2]_n\text{Het}^1$,
 Het denotes a mono- or bicyclic saturated, unsaturated or aromatic
 heterocycle having 1 to 4 N, O and/or S atoms, which is unsub-
 stituted or may be mono-, di- or trisubstituted by Hal, A, OR^6 ,
 10 $\text{N}(\text{R}^6)_2$, NO_2 , CN, COOR^6 , $\text{CON}(\text{R}^6)_2$, NR^3COA , $\text{NR}^6\text{SO}_2\text{A}$,
 $\text{SO}_2\text{N}(\text{R}^6)_2$, $\text{S}(\text{O})_m\text{A}$, NHCOOA , $\text{NHCON}(\text{R}^6)_2$, CHO, COA, =S,
 =NH, =NA and/or =O (carbonyl oxygen),
 Het¹ denotes a monocyclic aromatic heterocycle having 1 to 4 N, O
 and/or S atoms, which is unsubstituted or may be mono-, di- or
 15 trisubstituted, in each case independently of one another, by R^3 ,
 R^6 denotes H or A,
 A, A' each, independently of one another, denote unbranched or
 branched alkyl having 1-10 C atoms,
 20 in which 1-7 H atoms may be replaced by F, Cl and/or Br,
 and/or in which one or two CH_2 groups may be replaced by O, S,
 SO, SO_2 and/or CH=CH groups,
 or
 25 cyclic alkyl having 3-7 C atoms,
 Cyc denotes cycloalkylene having 3-7 C atoms,
 Hal denotes F, Cl, Br or I,
 m denotes 1, 2, 3 or 4,
 30 n denotes 0, 1, 2, 3 or 4,
 p denotes 1, 2, 3, 4 or 5,
 q denotes 1, 2, 3, 4 or 5,
 and pharmaceutically usable salts, tautomers and stereoisomers thereof,
 including mixtures thereof in all ratios,

Compounds of the formula I are also taken to mean the hydrates and solvates of these compounds, furthermore pharmaceutically usable derivatives.

The invention also relates to the optically active forms (stereoisomers), the enantiomers, the racemates, the diastereomers and the hydrates and solvates of these compounds. Solvates of the compounds are taken to mean adductions of inert solvent molecules onto the compounds which form owing to their mutual attractive force. Solvates are, for example, mono- or dihydrates or alcoholates.

Pharmaceutically usable derivatives are taken to mean, for example, the salts of the compounds according to the invention and also so-called pro-drug compounds.

Prodrug derivatives are taken to mean compounds of the formula I which have been modified by means of, for example, alkyl or acyl groups, sugars or oligopeptides and which are rapidly cleaved in the organism to form the effective compounds according to the invention.

These also include biodegradable polymer derivatives of the compounds according to the invention, as described, for example, in Int. J. Pharm. 115, 61-67 (1995).

The expression "effective amount" denotes the amount of a medicament or of a pharmaceutical active ingredient which causes in a tissue, system, animal or human a biological or medical response which is sought or desired, for example, by a researcher or physician.

In addition, the expression "therapeutically effective amount" denotes an amount which, compared with a corresponding subject who has not received this amount, has the following consequence: improved treatment, healing, prevention or elimination of a disease, syndrome, condition, complaint, disorder or side effects or also the reduction in the advance of a disease, complaint or disorder.

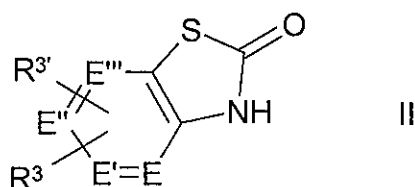
The term "therapeutically effective amount" also encompasses the amounts which are effective for increasing normal physiological function.

The invention also relates to the use of mixtures of the compounds of the formula I, for example mixtures of two diastereomers, for example in the ratio 1:1, 1:2, 1:3, 1:4, 1:5, 1:10, 1:100 or 1:1000.

These are particularly preferably mixtures of stereoisomeric compounds.

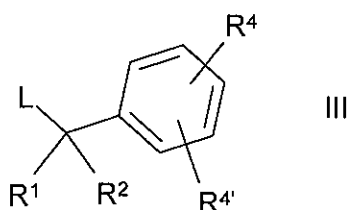
The invention relates to the compounds of the formula I and salts thereof and to a process for the preparation of compounds of the formula I according to Claims 1-11 and pharmaceutically usable derivatives, salts, solvates, tautomers and stereoisomers thereof, characterised in that

a) a compound of the formula II



in which E, E', E'', E''', R³ and R^{3'} have the meanings indicated in Claim 1,

is reacted with a compound of the formula III



in which R¹, R², R⁴ and R^{4'} have the meanings indicated in Claim 1 and L denotes Cl, Br, I or a free or reactively functionally modified OH group,

and/or

a base or acid of the formula I is converted into one of its salts.

Above and below, the radicals R^1 , R^2 , R^3 , R^3' , R^4 , R^4' , E, E', E" and E''' have the meanings indicated for the formula I, unless expressly indicated otherwise.

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Abbreviations:

TFA trifluoroacetic acid

DCM dichloromethane

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A, A' each, independently of one another, denote alkyl, is unbranched (linear) or branched, and has 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 C atoms. A preferably denotes methyl, furthermore ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl or tert-butyl, furthermore also pentyl, 1-, 2- or 3-methylbutyl, 1,1-, 1,2- or 2,2-dimethylpropyl, 1-ethylpropyl, hexyl, 1-, 2-, 3- or 4-methylpentyl, 1,1-, 1,2-, 1,3-, 2,2-, 2,3- or 3,3-dimethylbutyl, 1- or 2-ethylbutyl, 1-ethyl-1-methylpropyl, 1-ethyl-2-methylpropyl, 1,1,2- or 1,2,2-trimethylpropyl, further preferably, for example, trifluoromethyl.

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A very particularly preferably denotes alkyl having 1, 2, 3, 4, 5 or 6 C atoms, preferably methyl, ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl, tert-butyl, pentyl, hexyl, trifluoromethyl, pentafluoroethyl or 1,1,1-trifluoroethyl.

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Cyclic alkyl (cycloalkyl) preferably denotes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl or cycloheptyl.

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Ar denotes, for example, phenyl, o-, m- or p-tolyl, o-, m- or p-ethylphenyl, o-, m- or p-propylphenyl, o-, m- or p-isopropylphenyl, o-, m- or p-tert-butylphenyl, o-, m- or p-hydroxyphenyl, o-, m- or p-nitrophenyl, o-, m- or p-aminophenyl, o-, m- or p-(N-methylamino)phenyl, o-, m- or p-(N-methylaminocarbonyl)phenyl, o-, m- or p-acetamidophenyl, o-, m- or p-methoxyphenyl, o-, m- or p-ethoxyphenyl, o-, m- or p-ethoxycarbonylphenyl, o-, m- or p-(N,N-dimethylamino)phenyl, o-, m- or p-(N,N-dimethylaminocarbonyl)phenyl, o-, m- or p-(N-ethylamino)phenyl, o-, m- or p-(N,N-diethylamino)-

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phenyl, o-, m- or p-fluorophenyl, o-, m- or p-bromophenyl, o-, m- or p-chlorophenyl, o-, m- or p-(methylsulfonamido)phenyl, o-, m- or p-(methylsulfonyl)phenyl, o-, m- or p-methylsulfanylphenyl, o-, m- or p-cyanophenyl, o-, m- or p-carboxyphenyl, o-, m- or p-methoxycarbonylphenyl, o-, m- or p-aminosulfonylphenyl, further preferably 2,3-, 2,4-, 2,5-, 2,6-, 3,4- or 3,5-difluorophenyl, 2,3-, 2,4-, 2,5-, 2,6-, 3,4- or 3,5-dichlorophenyl, 2,3-, 2,4-, 2,5-, 2,6-, 3,4- or 3,5-dibromophenyl, 2,4- or 2,5-dinitrophenyl, 2,5- or 3,4-dimethoxyphenyl, 3-nitro-4-chlorophenyl, 3-amino-4-chloro-, 2-amino-3-chloro-, 2-amino-4-chloro-, 2-amino-5-chloro- or 2-amino-6-chlorophenyl, 2-nitro-4-N,N-dimethylamino- or 3-nitro-4-N,N-dimethylaminophenyl, 2,3-diaminophenyl, 2,3,4-, 2,3,5-, 2,3,6-, 2,4,6- or 3,4,5-trichlorophenyl, 2,4,6-trimethoxyphenyl, 2-hydroxy-3,5-dichlorophenyl, p-iodophenyl, 3,6-dichloro-4-aminophenyl, 4-fluoro-3-chlorophenyl, 2-fluoro-4-bromophenyl, 2,5-difluoro-4-bromophenyl, 3-bromo-6-methoxyphenyl, 3-chloro-6-methoxyphenyl, 3-chloro-4-acetamidophenyl, 3-fluoro-4-methoxyphenyl, 3-amino-6-methylphenyl, 3-chloro-4-acetamidophenyl or 2,5-dimethyl-4-chlorophenyl.

Ar particularly preferably denotes phenyl which is mono- di- or trisubstituted by Hal and/or CN.

Irrespective of further substitutions, Het denotes, for example, 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-, 2-, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4- or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, furthermore preferably 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl, pyrazinyl, 1-, 2-, 3-, 4-, 5-, 6- or 7-indolyl, 4- or 5-indolyl, indazolyl, 1-, 2-, 4- or 5-benzimidazolyl, 1-, 3-, 4-, 5-, 6- or 7-benzopyrazolyl, 2-, 4-, 5-, 6- or 7-benzoxazolyl, 3-, 4-, 5-, 6- or 7-benzisoxazolyl, 2-, 4-, 5-, 6- or 7-benzothiazolyl, 2-, 4-, 5-, 6- or 7-benzisothiazolyl, 4-, 5-,

5 6- or 7-benz-2,1,3-oxadiazolyl, 2-, 3-, 4-, 5-, 6-, 7- or 8-quinolyl, 1-, 3-, 4-, 5-, 6-, 7- or 8-isoquinolyl, 3-, 4-, 5-, 6-, 7- or 8-cinnolyl, 2-, 4-, 5-, 6-, 7- or 8-quinazolinyl, 5- or 6-quinoxalyl, 2-, 3-, 5-, 6-, 7- or 8-2H-benzo-1,4-oxazinyl, further preferably 1,3-benzodioxol-5-yl, 1,4-benzodioxan-6-yl, 2,1,3-benzothiadiazol-4- or -5-yl, 2,1,3-benzoxadiazol-5-yl or dibenzofuranyl.

The heterocyclic radicals may also be partially or fully hydrogenated. Irrespective of further substitutions, Het may thus also denote, for example, 10 2,3-dihydro-2-, -3-, -4- or -5-furyl, 2,5-dihydro-2-, -3-, -4- or 5-furyl, tetrahydro-2- or -3-furyl, 1,3-dioxolan-4-yl, tetrahydro-2- or -3-thienyl, 2,3-dihydro-1-, -2-, -3-, -4- or -5-pyrrolyl, 2,5-dihydro-1-, -2-, -3-, -4- or -5-pyrrolyl, 1-, 2- or 3-pyrrolidinyl, tetrahydro-1-, -2- or -4-imidazolyl, 2,3-dihydro-1-, -2-, -3-, -4- or -5-pyrazolyl, tetrahydro-1-, -3- or -4-pyrazolyl, 15 1,4-dihydro-1-, -2-, -3- or -4-pyridyl, 1,2,3,4-tetrahydro-1-, -2-, -3-, -4-, -5- or -6-pyridyl, 1-, 2-, 3- or 4-piperidinyl, 2-, 3- or 4-morpholinyl, tetrahydro-2-, -3- or -4-pyranyl, 1,4-dioxanyl, 1,3-dioxan-2-, -4- or -5-yl, hexahydro-1-, -3- or -4-pyridazinyl, hexahydro-1-, -2-, -4- or -5-pyrimidinyl, 1-, 2- or 3-piperazinyl, 1,2,3,4-tetrahydro-1-, -2-, -3-, -4-, -5-, -6-, -7- or -8-quinolyl, 1,2,3,4-tetrahydro-1-, -2-, -3-, -4-, -5-, -6-, -7- or -8-isoquinolyl, 2-, 3-, 5-, 6-, 7- or 8- 3,4-dihydro-2H-benzo-1,4-oxazinyl, further preferably 2,3-methylenedioxyphenyl, 3,4-methylenedioxyphenyl, 2,3-ethylenedioxyphenyl, 3,4-ethylenedioxyphenyl, 3,4-(difluoromethylenedioxy)phenyl, 2,3-dihydro-25 benzofuran-5- or 6-yl, 2,3-(2-oxomethylenedioxy)phenyl or also 3,4-dihydro-2H-1,5-benzodioxepin-6- or -7-yl, furthermore preferably 2,3-dihydrobenzofuranyl, 2,3-dihydro-2-oxofuranyl, 3,4-dihydro-2-oxo-1H-quinazolinyl, 2,3-dihydrobenzoxazolyl, 2-oxo-2,3-dihydrobenzoxazolyl, 2,3-dihydrobenzimidazolyl, 1,3-dihydroindole, 2-oxo-1,3-dihydroindole or 2-oxo-2,3-dihydrobenzimidazolyl.

35 In a further embodiment, Het preferably denotes a mono- or bicyclic saturated, unsaturated or aromatic heterocycle having 1 to 3 N, O and/or S

atoms, which is unsubstituted or may be mono-, di- or trisubstituted by A and/or =O (carbonyl oxygen).

5 Het particularly preferably denotes piperidinyl, pyrrolidinyl, morpholin-4-yl, piperazinyl, 1,3-oxazolidin-3-yl, imidazolidinyl, oxazolyl, oxadiazolyl, thiazolyl, thienyl, furanyl or pyridyl, where the radicals may also be mono- or disubstituted by A and/or =O (carbonyl oxygen).

10

Irrespective of further substitutions, Het¹ denotes, for example, 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-, 2, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4- or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, further preferably 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl or pyrazinyl.

20

Het¹ particularly preferably denotes 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-, 2, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4- or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl or pyrazinyl, which are unsubstituted or mono- or disubstituted by A, O(CH₂)_mNH₂, O(CH₂)_mNHA, O(CH₂)_mNAA', Het, OHet, N=CH-NAA', N=CH-NHA, N=CH-NH₂ and/or O(CH₂)_mHet.

30

E denotes C or N; E', E'', E''' preferably denote C.

R⁶ preferably denotes H, methyl, ethyl, propyl, isopropyl, butyl or tert-butyl.

Hal preferably denotes F, Cl or Br, but also, particularly preferably F or Cl.

35

Throughout the invention, all radicals which occur more than once may be identical or different, i.e. are independent of one another.

5 The compounds of the formula I may have one or more chiral centres and can therefore occur in various stereoisomeric forms. The formula I encompasses all these forms.

10 Accordingly, the invention relates, in particular, to the compounds of the formula I in which at least one of the said radicals has one of the preferred meanings indicated above. Some preferred groups of compounds may be expressed by the following sub-formulae Ia to Ig, which conform to the formula I and in which the radicals not designated in greater detail have the meaning indicated for the formula I, but in which

15 in Ia A, A' each, independently of one another, denotes unbranched or branched alkyl having 1-10 C atoms, in which 1-7 H atoms may be replaced by F and/or Cl;

20 in Ib Het denotes a monocyclic saturated, unsaturated or aromatic heterocycle having 1 to 3 N, O and/or S atoms, which is unsubstituted or may be mono- or disubstituted by A and/or COOR⁶;

25 in Ic Het denotes piperidiny, pyrrolidiny, morpholin-4-yl, piperaziny, 1,3-oxazolidin-3-yl, imidazolidiny, oxazolyl, oxadiazolyl, thiazolyl, thienyl, furanyl or pyridyl, where the radicals may also be mono- or disubstituted by A and/or COOR⁶;

30 in Id E, E', E'', E''' denote C;

35 in Ie R¹, R² denote H;

	in If	R^3	denotes A, COA, $(CH_2)_nHet$, Hal, $O(CH_2)_mNAA'$ or $O(CH_2)_mHet$;
5	in Ig	$R^{3'}$	denotes H;
	in Ih	R^4	denotes Het^1 , $NHCOOR^5$ or NO_2 ;
10	in Ii	$R^{4'}$	denotes H;
	in Ij	R^5	denotes $(CH_2)_mHet$;
15	in Ik	R^6	denotes H, methyl, ethyl, propyl, isopropyl, butyl or tert-butyl;
20	in Il	Het^1	denotes 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-, 2-, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4- or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl or pyrazinyl, which are unsubstituted or mono-
25			or disubstituted by A, $O(CH_2)_mNH_2$, $O(CH_2)_mNHA$, $O(CH_2)_mNAA'$, Het , $OHet$, $N=CH-NAA'$, $N=CH-NHA$, $N=CH-NH_2$ and/or $O(CH_2)_mHet$;
30			
	in Im	E, E', E'', E'''	denote C,
		R^1, R^2	denote H,
35		R^3	denotes A, COA, $(CH_2)_nHet$, Hal, $O(CH_2)_mNAA'$ or $O(CH_2)_mHet$,
		$R^{3'}$	denotes H,

	R ⁴	denotes Het ¹ , NHCOOR ⁵ or NO ₂ ,
	R ^{4'}	denotes H,
	R ⁵	denotes (CH ₂) _m Het,
5	Ar	denotes phenyl which is mono-, di- or trisubstituted by Hal and/or CN,
	Het	denotes piperidiny, pyrrolidiny, morpholin-4-yl, piperazinyl, 1,3-oxazolidin-3-yl, imidazolidiny, oxazolyl, oxadiazolyl, thiazolyl, thienyl, furanyl or pyridyl,
10		where the radicals may also be mono- or disubstituted by A and/or COOR ⁶ ,
	Het ¹	denotes 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-, 2, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4- or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl or pyrazinyl, which are unsubstituted or mono- or disubstituted by A, O(CH ₂) _m NH ₂ , O(CH ₂) _m NHA, O(CH ₂) _m NAA', Het, OHet, N=CH-NAA', N=CH-NHA, N=CH-NH ₂ and/or O(CH ₂) _m Het,
15		
20	R ⁶	denotes H, methyl, ethyl, propyl, isopropyl, butyl or tert-butyl,
	A, A'	each, independently of one another, denote unbranched or branched alkyl having 1-10 C atoms,
25		in which 1-7 H atoms may be replaced by F and/or Cl,
30	Hal	denotes F, Cl, Br or I,
	m	denotes 1, 2, 3 or 4;
35		

and pharmaceutically usable derivatives, salts, solvates, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

5 The compounds of the formula I and also the starting materials for their preparation are, in addition, prepared by methods known per se, as described in the literature (for example in the standard works, such as Houben-Weyl, Methoden der organischen Chemie [Methods of Organic Chemistry], Georg-Thieme-Verlag, Stuttgart), to be precise under reaction
10 conditions which are known and suitable for the said reactions. Use can also be made here of variants known per se which are not mentioned here in greater detail.

15 The starting compounds of the formulae II and III are generally known. If they are novel, however, they can be prepared by methods known per se.

Compounds of the formula I can preferably be obtained by reacting a compound of the formula II with a compound of the formula III.

20 In the compounds of the formula III, L preferably denotes Cl, Br, I or a free or reactively modified OH group, such as, for example, an activated ester, an imidazolidine or alkylsulfonyloxy having 1-6 C atoms (preferably methylsulfonyloxy or trifluoromethylsulfonyloxy) or arylsulfonyloxy having 6-10 C
25 atoms (preferably phenyl- or p-tolylsulfonyloxy).

The reaction is generally carried out in the presence of an acid-binding agent, preferably an organic base, such as DIPEA, triethylamine, dimethylaniline, pyridine or quinoline.

30 The addition of an alkali or alkaline-earth metal hydroxide, carbonate or bicarbonate or another salt of a weak acid of the alkali or alkaline-earth metals, preferably of potassium, sodium, calcium or caesium, may also be favourable.

35 Depending on the conditions used, the reaction time is between a few minutes and 14 days, the reaction temperature is between about -30° and

140°, normally between -10° and 90°, in particular between about 0° and about 70°.

Suitable inert solvents are, for example, hydrocarbons, such as hexane, petroleum ether, benzene, toluene or xylene; chlorinated hydrocarbons, such as trichloroethylene, 1,2-dichloroethane, carbon tetrachloride, chloroform or dichloromethane; alcohols, such as methanol, ethanol, isopropanol, n-propanol, n-butanol or tert-butanol; ethers, such as diethyl ether, diisopropyl ether, tetrahydrofuran (THF) or dioxane; glycol ethers, such as ethylene glycol monomethyl or monoethyl ether, ethylene glycol dimethyl ether (diglyme); ketones, such as acetone or butanone; amides, such as acetamide, dimethylacetamide, 1-methylpyrrolidinone (NMP) or dimethylformamide (DMF); nitriles, such as acetonitrile; sulfoxides, such as dimethyl sulfoxide (DMSO); carbon disulfide; carboxylic acids, such as formic acid or acetic acid; nitro compounds, such as nitromethane or nitrobenzene; esters, such as ethyl acetate, or mixtures of the said solvents. Particular preference is given to acetonitrile, dichloromethane, NMP and/or DMF.

Pharmaceutical salts and other forms

The said compounds according to the invention can be used in their final non-salt form. On the other hand, the present invention also encompasses the use of these compounds in the form of their pharmaceutically acceptable salts, which can be derived from various organic and inorganic acids and bases by procedures known in the art. Pharmaceutically acceptable salt forms of the compounds of the formula I are for the most part prepared by conventional methods. If the compound of the formula I contains a carboxyl group, one of its suitable salts can be formed by reacting the compound with a suitable base to give the corresponding base-addition salt. Such bases are, for example, alkali metal hydroxides, including potassium hydroxide, sodium hydroxide and lithium hydroxide; alkaline earth metal hydroxides, such as barium hydroxide and calcium hydroxide; alkali metal alkoxides, for example potassium ethoxide and sodium propoxide; and

various organic bases, such as piperidine, diethanolamine and N-methyl-glutamine. The aluminium salts of the compounds of the formula I are likewise included. In the case of certain compounds of the formula I, acid-addition salts can be formed by treating these compounds with pharmaceutically acceptable organic and inorganic acids, for example hydrogen halides, such as hydrogen chloride, hydrogen bromide or hydrogen iodide, other mineral acids and corresponding salts thereof, such as sulfate, nitrate or phosphate and the like, and alkyl- and monoarylsulfonates, such as ethanesulfonate, toluenesulfonate and benzenesulfonate, and other organic acids and corresponding salts thereof, such as acetate, trifluoroacetate, tartrate, maleate, succinate, citrate, benzoate, salicylate, ascorbate and the like. Accordingly, pharmaceutically acceptable acid-addition salts of the compounds of the formula I include the following: acetate, adipate, alginate, arginate, aspartate, benzoate, benzenesulfonate (besylate), bisulfate, bisulfite, bromide, butyrate, camphorate, camphorsulfonate, caprylate, chloride, chlorobenzoate, citrate, cyclopentanepropionate, digluconate, dihydrogenphosphate, dinitrobenzoate, dodecylsulfate, ethanesulfonate, fumarate, galacterate (from mucic acid), galacturonate, glucoheptanoate, gluconate, glutamate, glycerophosphate, hemisuccinate, hemisulfate, heptanoate, hexanoate, hippurate, hydrochloride, hydrobromide, hydroiodide, 2-hydroxyethanesulfonate, iodide, isethionate, isobutyrate, lactate, lactobionate, malate, maleate, malonate, mandelate, metaphosphate, methanesulfonate, methylbenzoate, monohydrogenphosphate, 2-naphthalenesulfonate, nicotinate, nitrate, oxalate, oleate, palmoate, pectinate, persulfate, phenylacetate, 3-phenylpropionate, phosphate, phosphonate, phthalate, but this does not represent a restriction.

Furthermore, the base salts of the compounds according to the invention include aluminium, ammonium, calcium, copper, iron(III), iron(II), lithium, magnesium, manganese(III), manganese(II), potassium, sodium and zinc salts, but this is not intended to represent a restriction. Of the above-mentioned salts, preference is given to ammonium; the alkali metal salts

sodium and potassium, and the alkaline earth metal salts calcium and magnesium. Salts of the compounds of the formula I which are derived from pharmaceutically acceptable organic non-toxic bases include salts of primary, secondary and tertiary amines, substituted amines, also including naturally occurring substituted amines, cyclic amines, and basic ion exchanger resins, for example arginine, betaine, caffeine, chlorprocaine, choline, N,N'-dibenzylethylenediamine (benzathine), dicyclohexylamine, diethanolamine, diethylamine, 2-diethylaminoethanol, 2-dimethylaminoethanol, ethanolamine, ethylenediamine, N-ethylmorpholine, N-ethylpiperidine, glucamine, glucosamine, histidine, hydrabamine, isopropylamine, lidocaine, lysine, meglumine, N-methyl-D-glucamine, morpholine, piperazine, piperidine, polyamine resins, procaine, purines, theobromine, triethanolamine, triethylamine, trimethylamine, tripropylamine and tris-(hydroxymethyl)methylamine (tromethamine), but this is not intended to represent a restriction.

Compounds of the present invention which contain basic nitrogen-containing groups can be quaternised using agents such as (C₁-C₄)alkyl halides, for example methyl, ethyl, isopropyl and tert-butyl chloride, bromide and iodide; di(C₁-C₄)alkyl sulfates, for example dimethyl, diethyl and diamyl sulfate; (C₁₀-C₁₈)alkyl halides, for example decyl, dodecyl, lauryl, myristyl and stearyl chloride, bromide and iodide; and aryl(C₁-C₄)alkyl halides, for example benzyl chloride and phenethyl bromide. Both water- and oil-soluble compounds according to the invention can be prepared using such salts.

The above-mentioned pharmaceutical salts which are preferred include acetate, trifluoroacetate, besylate, citrate, fumarate, gluconate, hemisuccinate, hippurate, hydrochloride, hydrobromide, isethionate, mandelate, meglumine, nitrate, oleate, phosphonate, pivalate, sodium phosphate, stearate, sulfate, sulfosalicylate, tartrate, thiomalate, tosylate and tromethamine, but this is not intended to represent a restriction.

Particular preference is given to hydrochloride, dihydrochloride, hydrobromide, maleate, mesylate, phosphate, sulfate and succinate.

5 The acid-addition salts of basic compounds of the formula I are prepared by bringing the free base form into contact with a sufficient amount of the desired acid, causing the formation of the salt in a conventional manner. The free base can be regenerated by bringing the salt form into contact
10 with a base and isolating the free base in a conventional manner. The free base forms differ in a certain respect from the corresponding salt forms thereof with respect to certain physical properties, such as solubility in polar solvents; for the purposes of the invention, however, the salts otherwise correspond to the respective free base forms thereof.
15

As mentioned, the pharmaceutically acceptable base-addition salts of the compounds of the formula I are formed with metals or amines, such as
20 alkali metals and alkaline earth metals or organic amines. Preferred metals are sodium, potassium, magnesium and calcium. Preferred organic amines are N,N'-dibenzylethylenediamine, chloroprocaine, choline, diethanolamine, ethylenediamine, N-methyl-D-glucamine and procaine.

25 The base-addition salts of acidic compounds according to the invention are prepared by bringing the free acid form into contact with a sufficient amount of the desired base, causing the formation of the salt in a conventional manner. The free acid can be regenerated by bringing the salt form
30 into contact with an acid and isolating the free acid in a conventional manner. The free acid forms differ in a certain respect from the corresponding salt forms thereof with respect to certain physical properties, such as solubility in polar solvents; for the purposes of the invention, however, the salts
35 otherwise correspond to the respective free acid forms thereof.

If a compound according to the invention contains more than one group which is capable of forming pharmaceutically acceptable salts of this type, the invention also encompasses multiple salts. Typical multiple salt forms include, for example, bitartrate, diacetate, difumarate, dimeglumine, diphosphate, disodium and trihydrochloride, but this is not intended to represent a restriction.

With regard to that stated above, it can be seen that the expression "pharmaceutically acceptable salt" in the present connection is taken to mean an active ingredient which comprises a compound of the formula I in the form of one of its salts, in particular if this salt form imparts improved pharmacokinetic properties on the active ingredient compared with the free form of the active ingredient or any other salt form of the active ingredient used earlier. The pharmaceutically acceptable salt form of the active ingredient can also provide this active ingredient for the first time with a desired pharmacokinetic property which it did not have earlier and can even have a positive influence on the pharmacodynamics of this active ingredient with respect to its therapeutic efficacy in the body.

The invention furthermore relates to medicaments comprising at least one compound of the formula I and/or pharmaceutically usable derivatives, solvates and stereoisomers thereof, including mixtures thereof in all ratios, and optionally excipients and/or adjuvants.

Pharmaceutical formulations can be administered in the form of dosage units which comprise a predetermined amount of active ingredient per dosage unit. Such a unit can comprise, for example, 0.5 mg to 1 g, preferably 1 mg to 700 mg, particularly preferably 5 mg to 100 mg, of a compound according to the invention, depending on the condition treated, the method of administration and the age, weight and condition of the patient, or pharmaceutical formulations can be administered in the form of dosage units which comprise a predetermined amount of active ingredient per

dosage unit. Preferred dosage unit formulations are those which comprise a daily dose or part-dose, as indicated above, or a corresponding fraction thereof of an active ingredient. Furthermore, pharmaceutical formulations of this type can be prepared using a process which is generally known in the pharmaceutical art.

Pharmaceutical formulations can be adapted for administration via any desired suitable method, for example by oral (including buccal or sublingual), rectal, nasal, topical (including buccal, sublingual or transdermal), vaginal or parenteral (including subcutaneous, intramuscular, intravenous or intradermal) methods. Such formulations can be prepared using all processes known in the pharmaceutical art by, for example, combining the active ingredient with the excipient(s) or adjuvant(s).

Pharmaceutical formulations adapted for oral administration can be administered as separate units, such as, for example, capsules or tablets; powders or granules; solutions or suspensions in aqueous or non-aqueous liquids; edible foams or foam foods; or oil-in-water liquid emulsions or water-in-oil liquid emulsions.

Thus, for example, in the case of oral administration in the form of a tablet or capsule, the active-ingredient component can be combined with an oral, non-toxic and pharmaceutically acceptable inert excipient, such as, for example, ethanol, glycerol, water and the like. Powders are prepared by comminuting the compound to a suitable fine size and mixing it with a pharmaceutical excipient comminuted in a similar manner, such as, for example, an edible carbohydrate, such as, for example, starch or mannitol. A flavour, preservative, dispersant and dye may likewise be present.

Capsules are produced by preparing a powder mixture as described above and filling shaped gelatine shells therewith. Glidants and lubricants, such as, for example, highly disperse silicic acid, talc, magnesium stearate, cal-

5 cium stearate or polyethylene glycol in solid form, can be added to the powder mixture before the filling operation. A disintegrant or solubiliser, such as, for example, agar-agar, calcium carbonate or sodium carbonate, may likewise be added in order to improve the availability of the medica-
ment after the capsule has been taken.

10 In addition, if desired or necessary, suitable binders, lubricants and disintegrants as well as dyes can likewise be incorporated into the mixture. Suitable binders include starch, gelatine, natural sugars, such as, for example, glucose or beta-lactose, sweeteners made from maize, natural and synthetic rubber, such as, for example, acacia, tragacanth or sodium alginate, carboxymethylcellulose, polyethylene glycol, waxes, and the like. The
15 lubricants used in these dosage forms include sodium oleate, sodium stearate, magnesium stearate, sodium benzoate, sodium acetate, sodium chloride and the like. The disintegrants include, without being restricted thereto, starch, methylcellulose, agar, bentonite, xanthan gum and the like.
20 The tablets are formulated by, for example, preparing a powder mixture, granulating or dry-pressing the mixture, adding a lubricant and a disintegrant and pressing the entire mixture to give tablets. A powder mixture is prepared by mixing the compound comminuted in a suitable manner with a diluent or a base, as described above, and optionally with a binder, such
25 as, for example, carboxymethylcellulose, an alginate, gelatine or polyvinylpyrrolidone, a dissolution retardant, such as, for example, paraffin, an absorption accelerator, such as, for example, a quaternary salt, and/or an absorbant, such as, for example, bentonite, kaolin or dicalcium phosphate.
30 The powder mixture can be granulated by wetting it with a binder, such as, for example, syrup, starch paste, acacia mucilage or solutions of cellulose or polymer materials and pressing it through a sieve. As an alternative to granulation, the powder mixture can be run through a tableting machine, giving lumps of non-uniform shape, which are broken up to form granules.
35 The granules can be lubricated by addition of stearic acid, a stearate salt, talc or mineral oil in order to prevent sticking to the tablet casting moulds.

5 The lubricated mixture is then pressed to give tablets. The compounds according to the invention can also be combined with a free-flowing inert excipient and then pressed directly to give tablets without carrying out the granulation or dry-pressing steps. A transparent or opaque protective layer consisting of a shellac sealing layer, a layer of sugar or polymer material and a gloss layer of wax may be present. Dyes can be added to these coatings in order to be able to differentiate between different dosage units.

10 Oral liquids, such as, for example, solution, syrups and elixirs, can be prepared in the form of dosage units so that a given quantity comprises a pre-specified amount of the compound. Syrups can be prepared by dissolving the compound in an aqueous solution with a suitable flavour, while elixirs
15 are prepared using a non-toxic alcoholic vehicle. Suspensions can be formulated by dispersion of the compound in a non-toxic vehicle. Solubilisers and emulsifiers, such as, for example, ethoxylated isostearyl alcohols and polyoxyethylene sorbitol ethers, preservatives, flavour additives, such as, for example, peppermint oil or natural sweeteners or saccharin, or other
20 artificial sweeteners and the like, can likewise be added.

(The dosage unit formulations for oral administration can, if desired, be encapsulated in microcapsules. The formulation can also be prepared in
25 such a way that the release is extended or retarded, such as, for example, by coating or embedding of particulate material in polymers, wax and the like.

30 The compounds of the formula I and salts, solvates and physiologically functional derivatives thereof can also be administered in the form of liposome delivery systems, such as, for example, small unilamellar vesicles, large unilamellar vesicles and multilamellar vesicles. Liposomes can be
35 formed from various phospholipids, such as, for example, cholesterol, stearylamine or phosphatidylcholines.

The compounds of the formula I and the salts, solvates and physiologically functional derivatives thereof can also be delivered using monoclonal antibodies as individual carriers to which the compound molecules are coupled. The compounds can also be coupled to soluble polymers as targeted medicament carriers. Such polymers may encompass polyvinylpyrrolidone, pyran copolymer, polyhydroxypropylmethacrylamidophenol, polyhydroxyethylaspartamidophenol or polyethylene oxide polylysine, substituted by palmitoyl radicals. The compounds may furthermore be coupled to a class of biodegradable polymers which are suitable for achieving controlled release of a medicament, for example polylactic acid, poly-epsilon-caprolactone, polyhydroxybutyric acid, polyorthoesters, polyacetals, polydihydroxypyrans, polycyanoacrylates and crosslinked or amphipathic block copolymers of hydrogels.

Pharmaceutical formulations adapted for transdermal administration can be administered as independent plasters for extended, close contact with the epidermis of the recipient. Thus, for example, the active ingredient can be delivered from the plaster by iontophoresis, as described in general terms in *Pharmaceutical Research*, 3(6), 318 (1986).

Pharmaceutical compounds adapted for topical administration can be formulated as ointments, creams, suspensions, lotions, powders, solutions, pastes, gels, sprays, aerosols or oils.

For the treatment of the eye or other external tissue, for example mouth and skin, the formulations are preferably applied as topical ointment or cream. In the case of formulation to give an ointment, the active ingredient can be employed either with a paraffinic or a water-miscible cream base. Alternatively, the active ingredient can be formulated to give a cream with an oil-in-water cream base or a water-in-oil base.

Pharmaceutical formulations adapted for topical application to the eye include eye drops, in which the active ingredient is dissolved or suspended in a suitable carrier, in particular an aqueous solvent.

5 Pharmaceutical formulations adapted for topical application in the mouth encompass lozenges, pastilles and mouthwashes.

10 Pharmaceutical formulations adapted for rectal administration can be administered in the form of suppositories or enemas.

15 Pharmaceutical formulations adapted for nasal administration in which the carrier substance is a solid comprise a coarse powder having a particle size, for example, in the range 20-500 microns, which is administered in the manner in which snuff is taken, i.e. by rapid inhalation via the nasal passages from a container containing the powder held close to the nose. Suitable formulations for administration as nasal spray or nose drops with a liquid as carrier substance encompass active-ingredient solutions in
20 water or oil.

25 Pharmaceutical formulations adapted for administration by inhalation encompass finely particulate dusts or mists, which can be generated by various types of pressurised dispensers with aerosols, nebulisers or insufflators.

30 Pharmaceutical formulations adapted for vaginal administration can be administered as pessaries, tampons, creams, gels, pastes, foams or spray formulations.

35 Pharmaceutical formulations adapted for parenteral administration include aqueous and non-aqueous sterile injection solutions comprising antioxidants, buffers, bacteriostatics and solutes, by means of which the formulation is rendered isotonic with the blood of the recipient to be treated; and

aqueous and non-aqueous sterile suspensions, which may comprise suspension media and thickeners. The formulations can be administered in single-dose or multidose containers, for example sealed ampoules and vials, and stored in freeze-dried (lyophilised) state, so that only the addition of the sterile carrier liquid, for example water for injection purposes, immediately before use is necessary. Injection solutions and suspensions prepared in accordance with the recipe can be prepared from sterile powders, granules and tablets.

It goes without saying that, in addition to the above particularly mentioned constituents, the formulations may also comprise other agents usual in the art with respect to the particular type of formulation; thus, for example, formulations which are suitable for oral administration may comprise flavours.

A therapeutically effective amount of a compound of the formula I depends on a number of factors, including, for example, the age and weight of the animal, the precise condition that requires treatment, and its severity, the nature of the formulation and the method of administration, and is ultimately determined by the treating doctor or vet. However, an effective amount of a compound according to the invention for the treatment of neoplastic growth, for example colon or breast carcinoma, is generally in the range from 0.1 to 100 mg/kg of body weight of the recipient (mammal) per day and particularly typically in the range from 1 to 10 mg/kg of body weight per day. Thus, the actual amount per day for an adult mammal weighing 70 kg is usually between 70 and 700 mg, where this amount can be administered as a single dose per day or usually in a series of part-doses (such as, for example, two, three, four, five or six) per day, so that the total daily dose is the same. An effective amount of a salt or solvate or of a physiologically functional derivative thereof can be determined as the fraction of the effective amount of the compound according to the invention

per se. It can be assumed that similar doses are suitable for the treatment of other conditions mentioned above.

5 The invention furthermore relates to medicaments comprising at least one compound of the formula I and/or pharmaceutically usable derivatives, solvates and stereoisomers thereof, including mixtures thereof in all ratios, and at least one further medicament active ingredient.

10 The invention also relates to a set (kit) consisting of separate packs of
(a) an effective amount of a compound of the formula I and/or pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios,
15 and
(b) an effective amount of a further medicament active ingredient.

The set comprises suitable containers, such as boxes, individual bottles, bags or ampoules. The set may, for example, comprise separate ampoules, each containing an effective amount of a compound of the formula I
20 and/or pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios,
and an effective amount of a further medicament active ingredient in dissolved or lyophilised form.
25

USE

30 The present compounds are suitable as pharmaceutical active ingredients for mammals, especially for humans, in the treatment of tyrosine kinase-induced diseases. These diseases include the proliferation of tumour cells, pathological neovascularisation (or angiogenesis) which promotes the growth of solid tumours, ocular neovascularisation (diabetic retinopathy,
35 age-induced macular degeneration and the like) and inflammation (psoriasis, rheumatoid arthritis and the like).

5 The present invention encompasses the use of the compounds of the formula I and/or physiologically acceptable salts and solvates thereof for the preparation of a medicament for the treatment or prevention of cancer.

Preferred carcinomas for the treatment originate from the group cerebral carcinoma, urogenital tract carcinoma, carcinoma of the lymphatic system, stomach carcinoma, laryngeal carcinoma and lung carcinoma. A further group of preferred forms of cancer are monocytic leukaemia, lung adeno-
10 carcinoma, small-cell lung carcinomas, pancreatic cancer, glioblastomas and breast carcinoma.

Also encompassed is the use of the compounds according to Claim 1 according to the invention and/or physiologically acceptable salts and sol-
15 vates thereof for the preparation of a medicament for the treatment or prevention of a disease in which angiogenesis is implicated.

Such a disease in which angiogenesis is implicated is an ocular disease, such as retinal vascularisation, diabetic retinopathy, age-induced macular
20 degeneration and the like.

The use of compounds of the formula I and/or physiologically acceptable salts and solvates thereof for the preparation of a medicament for the treatment or prevention of inflammatory diseases also falls within the
25 scope of the present invention. Examples of such inflammatory diseases include rheumatoid arthritis, psoriasis, contact dermatitis, delayed hypersensitivity reaction and the like.

Also encompassed is the use of the compounds of the formula I and/or physiologically acceptable salts and solvates thereof for the preparation of
30 a medicament for the treatment or prevention of a tyrosine kinase-induced disease or a tyrosine kinase-induced condition in a mammal, in which to this method a therapeutically effective amount of a compound according to the invention is administered to a sick mammal in need of such treatment.

35 The therapeutic amount varies according to the specific disease and can be determined by the person skilled in the art without undue effort.

The present invention also encompasses the use compounds of the formula I and/or physiologically acceptable salts and solvates thereof for the preparation of a medicament for the treatment or prevention of retinal vascularisation.

5 Methods for the treatment or prevention of ocular diseases, such as diabetic retinopathy and age-induced macular degeneration, are likewise part of the invention. The use for the treatment or prevention of inflammatory diseases, such as rheumatoid arthritis, psoriasis, contact dermatitis and
10 delayed hypersensitivity reaction, as well as the treatment or prevention of bone pathologies from the group osteosarcoma, osteoarthritis and rickets, likewise falls within the scope of the present invention.

The expression "tyrosine kinase-induced diseases or conditions" refers to
15 pathological conditions that depend on the activity of one or more tyrosine kinases. Tyrosine kinases either directly or indirectly participate in the signal transduction pathways of a variety of cellular activities, including proliferation, adhesion and migration and differentiation. Diseases associated
20 with tyrosine kinase activity include proliferation of tumour cells, pathological neovascularisation that promotes the growth of solid tumours, ocular neovascularisation (diabetic retinopathy, age-induced macular degeneration and the like) and inflammation (psoriasis, rheumatoid arthritis and the like).

25 The compounds of the formula I can be administered to patients for the treatment of cancer, in particular fast-growing tumours.

30 The invention thus relates to the use of compounds of the formula I, and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios, for the preparation of a medicament for the treatment of diseases in which the inhibition, regulation and/or
35 modulation of kinase signal transduction plays a role.

Preference is given here to Met kinase.

Preference is given to the use of compounds of the formula I, and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios,
5 for the preparation of a medicament for the treatment of diseases which are influenced by inhibition of tyrosine kinases by the compounds according to Claim 1.

10 Particular preference is given to the use for the preparation of a medicament for the treatment of diseases which are influenced by inhibition of Met kinase by the compounds according to Claim 1.
Especial preference is given to the use for the treatment of a disease
15 where the disease is a solid tumour.

The solid tumour is preferably selected from the group of tumours of the lung, of the squamous epithelium, of the bladder, of the stomach, of the kidneys, of head and neck, of the oesophagus, of the cervix, of the thyroid,
20 of the intestine, of the liver, of the brain, of the prostate, of the urogenital tract, of the lymphatic system, of the stomach and/or of the larynx.

The solid tumour is furthermore preferably selected from the group lung adenocarcinoma, small-cell lung carcinomas, pancreatic cancer, glioblastomas, colon carcinoma and breast carcinoma.

Preference is furthermore given to the use for the treatment of a tumour of the blood and immune system, preferably for the treatment of a tumour selected from the group of acute myeloid leukaemia, chronic myeloid leukaemia, acute lymphatic leukaemia and/or chronic lymphatic leukaemia.

35 The disclosed compounds of the formula I can be administered in combination with other known therapeutic agents, including anticancer agents. As used here, the term "anticancer agent" relates to any agent which is

administered to a patient with cancer for the purposes of treating the cancer.

5 The anti-cancer treatment defined herein may be applied as a sole therapy or may involve, in addition to the compound of the invention, conventional surgery or radiotherapy or chemotherapy. Such chemotherapy may include one or more of the following categories of anti- tumour agents:

10 (i) antiproliferative/antineoplastic/DNA-damaging agents and combinations thereof, as used in medical oncology, such as alkylating agents (for example cis-platin, carboplatin, cyclophosphamide, nitrogen mustard, melphalan, chloroambucil, busulphan and nitrosoureas); antimetabolites (for example antifolates such as fluoropyrimidines like 5-fluorouracil and tegafur, raltitrexed, methotrexate, cytosine arabinoside, hydroxyurea and gemcitabine); antitumour antibiotics (for example anthracyclines, like adriamycin, bleomycin, doxorubicin, daunomycin, epirubicin, idarubicin, mitomycin-C, dactinomycin and mithramycin) ; antimitotic agents (for
15 example vinca alkaloids, like vincristine, vinblastine, vindesine and vinorelbine, and taxoids, like taxol and taxotere) ; topoisomerase inhibitors (for example epipodophyllotoxins, like etoposide and teniposide, amsacrine, topotecan, irinotecan and camptothecin) and cell-differentiating agents (for example all-trans-retinoic acid, 13-cis-retinoic acid and fenretinide);
20 (ii) cytostatic agents, such as antioestrogens (for example tamoxifen, toremifene, raloxifene, droloxifene and idoxifene), oestrogen receptor downregulators (for example fulvestrant), antiandrogens (for example bicalutamide, flutamide, nilutamide and cyproterone acetate), LHRH antagonists or LHRH agonists (for example goserelin, leuprorelin and buserelin),
25 progestermes (for example megestrol acetate), aromatase inhibitors (for example as anastrozole, letrozole, vorazole and exemestane) and inhibitors of 5 α -reductase, such as finasteride;

35

- (iii) agents which inhibit cancer cell invasion (for example metallo-proteinase inhibitors, like marimastat, and inhibitors of urokinase plasminogen activator receptor function);
- 5 (iv) inhibitors of growth factor function, for example such inhibitors include growth factor antibodies, growth factor receptor antibodies (for example the anti-erb2 antibody trastuzumab [HerceptinTM] and the anti-erb3 antibody cetuximab [C225]), farnesyl transferase inhibitors, tyrosine kinase inhibitors and serine/threonine kinase inhibitors, for example inhibitors of the epidermal growth factor family (for example EGFR family tyrosine kinase inhibitors, such as N-(3-chloro-4-fluorophenyl)-7-methoxy-6-(3-morpholinopropoxy) quinazolin-4-amine (gefitinib, AZD1839), N-(3-ethynylphenyl)-6,7-bis (2-methoxyethoxy)quinazolin-4-amine (erlotinib, OSI-774) and 6-acrylamido-N-(3-chloro-4-fluorophenyl)-7-(3-morpholinopropoxy)quinazolin-4-amine (CI 1033)), for example inhibitors of the platelet-derived growth factor family and for example inhibitors of the hepatocyte growth factor family;
- 10 (v) antiangiogenic agents, such as those which inhibit the effects of vascular endothelial growth factor, (for example the anti-vascular endothelial cell growth factor antibody bevacizumab [AvastinTM], compounds such as those disclosed in published international patent applications WO 97/22596, WO 97/30035, WO 97/32856 and WO 98/13354) and
- 15 (vi) compounds that work by other mechanisms (for example linomide, inhibitors of integrin $\alpha v \beta 3$ function and angiostatin);
- 20 (vii) vessel-damaging agents, such as combretastatin A4 and compounds disclosed in international patent applications WO 99/02166, WO 00/40529, WO 00/41669, WO 01/92224, WO 02/04434 and
- 25 (viii) WO 02/08213;
- 30 (ix) antisense therapies, for example those which are directed to the targets listed above, such as ISIS 2503, an anti-Ras antisense;
- 35 (x) gene therapy approaches, including, for example, approaches for replacement of aberrant genes, such as aberrant p53 or aberrant BRCA1

or BRCA2, GDEPT (gene-directed enzyme pro-drug therapy) approaches, such as those using cytosine deaminase, thymidine kinase or a bacterial nitroreductase enzyme, and approaches for increasing patient tolerance to chemotherapy or radiotherapy, such as multi-drug resistance gene therapy; and

(ix) immunotherapy approaches, including, for example, ex-vivo and in-vivo approaches for increasing the immunogenicity of patient tumour cells, such as transfection with cytokines, such as interleukin 2, interleukin 4 or granulocyte-macrophage colony stimulating factor, approaches for decreasing T-cell anergy, approaches using transfected immune cells, such as cytokine-transfected dendritic cells, approaches using cytokine-transfected tumour cell lines, and approaches using anti-idiotypic antibodies.

The medicaments from Table 1 below are preferably, but not exclusively, combined with the compounds of the formula I.

Table 1.		
Alkylating agents	Cyclophosphamide Busulfan Ifosfamide Melphalan Hexamethylmelamine Thiotepa Chloroambucil Dacarbazine Carmustine	Lomustine Procarbazine Altretamine Estramustine phosphate Mechloroethamine Streptozocin Temozolomide Semustine
Platinum agents	Cisplatin Oxaliplatin Spiroplatin Carboxyphthalatoplatinum Tetraplatin Ormiplatin Iproplatin	Carboplatin ZD-0473 (AnorMED) Lobaplatin (Aetema) Satraplatin (Johnson Matthey) BBR-3464 (Hoffmann-La Roche) SM-11355 (Sumitomo) AP-5280 (Access)

5	Antimetabolites	Azacytidine Gemcitabine Capecitabine 5-Fluorouracil Floxuridine 2-Chlorodesoxyadenosine 6-Mercaptopurine 6-Thioguanine Cytarabine 2-Fluorodesoxycytidine Methotrexate Idatrexate	Tomudex Trimetrexate Deoxycoformycin Fludarabine Pentostatin Raltitrexed Hydroxyurea Decitabine (SuperGen) Clofarabine (Bioenvision) Irofulven (MGI Pharma) DMDC (Hoffmann-La Roche) Ethinylcytidine (Taiho)
10			
15	Topoisomerase inhibitors	Amsacrine Epirubicin Etoposide Teniposide or mitoxantrone Irinotecan (CPT-11) 7-Ethyl-10-hydroxycamptothecin Topotecan Dexrazoxanet (TopoTarget) Pixantrone (Novuspharma) Rebeccamycin analogue (Exelixis) BBR-3576 (Novuspharma)	Rubitecan (SuperGen) Exatecan mesylate (Daiichi) Quinamed (ChemGenex) Gimatecan (Sigma- Tau) Diflomotecan (Beaufour-Ipsen) TAS-103 (Taiho) Elsamitrucin (Spectrum) J-107088 (Merck & Co) BNP-1350 (BioNumerik) CKD-602 (Chong Kun Dang) KW-2170 (Kyowa Hakko)
20			
25	Antitumour antibiotics	Dactinomycin (Actinomycin D) Doxorubicin (Adriamycin) Deoxyrubicin Valrubicin Daunorubicin (Daunomycin) Epirubicin Therarubicin Idarubicin Rubidazon Plicamycinp Porfiromycin Cyanomorpholinodoxorubici Mitoxantron (Novantron)	Amonafide Azonafide Anthrapyrazole Oxantrazole Losoxantrone Bleomycin sulfate (Blenoxar) Bleomycinic acid Bleomycin A Bleomycin B Mitomycin C MEN-10755 (Menarini) GPX-100 (Gem Pharmaceuticals)
30			
35	Antimitotic agents	Paclitaxel Docetaxel Colchicine Vinblastine Vincristine	SB 408075 (GlaxoSmithKline) E7010 (Abbott) PG-TXL (Cell Therapeutics) IDN 5109 (Bayer)

5		Vinorelbine Vindesine Dolastatin 10 (NCI) Rhizoxin (Fujisawa) Mivobulin (Warner-Lambert) Cemadotin (BASF) RPR 109881A (Aventis) TXD 258 (Aventis) Epothilone B (Novartis) T 900607 (Tularik) T 138067 (Tularik) Cryptophycin 52 (Eli Lilly) Vinflunine (Fabre) Auristatin PE (Teikoku Hormone) BMS 247550 (BMS) BMS 184476 (BMS) BMS 188797 (BMS) Taxoprexin (Protarga)	A 105972 (Abbott) A 204197 (Abbott) LU 223651 (BASF) D 24851 (ASTA Medica) ER-86526 (Eisai) Combretastatin A4 (BMS) Isohomohalichondrin-B (PharmaMar) ZD 6126 (AstraZeneca) PEG-Paclitaxel (Enzon) AZ10992 (Asahi) IDN-5109 (Indena) AVLB (Prescient NeuroPharma) Azaepothilon B (BMS) BNP- 7787 (BioNumerik) CA-4-prodrug (OXiGENE) Dolastatin-10 (NrH) CA-4 (OXiGENE)
10			
15			
	Aromatase inhibitors	Aminoglutethimide Letrozole Anastrozole Formestan	Exemestan Atamestan (BioMedicines) YM-511 (Yamanouchi)
20			
	Thymidylate synthase inhibitors	Pemetrexed (Eli Lilly) ZD-9331 (BTG)	Nolatrexed (Eximias) CoFactor™ (BioKeys)
25			
	DNA antagonists	Trabectedin (PharmaMar) Glufosfamide (Baxter International) Albumin + 32P (Isotope Solutions) Thymectacin (NewBiotics) Edotreotid (Novartis)	Mafosfamide (Baxter International) Apaziquone (Spectrum Pharmaceuticals) O6-benzylguanine (Paligent)
30			
	Farnesyl transferase inhibitors	Arglabin (NuOncology Labs) lonafarnib (Schering-Plough Johnson) BAY-43-9006 (Bayer)	Tipifarnib (Johnson & Johnson) Perillyl alcohol (DOR BioPharma)
35			
	Pump inhibitors	CBT-1 (CBA Pharma) Tariquidar (Xenova) MS-209 (Schering AG)	Zosuquidar trihydrochloride (Eli Lilly) Biricodar dicitrate (Vertex)

	Histone acetyl transferase inhibitors	Tacedinaline (Pfizer) SAHA (Aton Pharma) MS-275 (Schering AG)	Pivaloyloxymethyl butyrate (Titan) Depsipeptide (Fujisawa)
5	Metalloproteinase inhibitors Ribonucleoside reductase inhibitors	Neovastat (Aeterna Laboratories) Marimastat (British Biotech) Gallium maltolate (Titan) Triapin (Vion)	CMT -3 (CollaGenex) BMS-275291 (Celltech) Tezacitabine (Aventis) Didox (Molecules for Health)
10	TNF-alpha agonists / antagonists	Virulizin (Lorus Therapeutics) CDC-394 (Celgene)	Revimid (Celgene)
	Endothelin-A receptor antagonists	Atrasentan (Abbot) ZD-4054 (AstraZeneca)	YM-598 (Yamanouchi)
15	Retinoic acid receptor agonists	Fenretinide (Johnson & Johnson) LGD-1550 (ligand)	Alitretinoin (Ligand)
20	Immunomodulators	Interferon Oncophage (Antigenics) GMK (Progenics) Adenocarcinoma vaccine (Biomira) CTP-37 (AVI BioPharma) JRX-2 (Immuno-Rx) PEP-005 (Peplin Biotech) Synchrovax vaccines (CTL Immuno) Melanoma vaccine (CTL Immuno) p21-RAS vaccine (GemVax)	Dexosome therapy (Anosys) Pentrix (Australian Cancer Technology) JSF-154 (Tragen) Cancer vaccine (Intercell) Norelin (Biostar) BLP-25 (Biomira) MGV (Progenics) 13-Alethin (Dovetail) CLL-Thera (Vasogen)
30	Hormonal and antihormonal agents	Oestrogens Conjugated oestrogens Ethinylloestradiol Chlorotrianisene Idenestrol Hydroxyprogesterone caproate Medroxyprogesterone Testosterone Testosterone propionate Fluoxymesterone	Prednisone Methylprednisolone Prednisolone Aminoglutethimide Leuprolide Goserelin Leuporelin Bicalutamide Flutamide Octreotide
35			

5		Methyltestosterone Diethylstilbestrol Megestrol Tamoxifen Toremofin Dexamethasone	Nilutamide Mitotan P-04 (Novogen) 2-Methoxyoestradiol (EntreMed) Arzoxifen (Eli Lilly)
10	Photodynamic agents	Talaporfin (Light Sciences) Theralux (Theratechnologies) Motexafin-Gadolinium (Pharmacyclics)	Pd-Bacteriopheophorbid (Yeda) Lutetium-Texaphyrin (Pharmacyclics) Hypericin
15	Tyrosine kinase inhibitors	Imatinib (Novartis) Leflunomide(Sugen/Pharmacia) ZD1839 (AstraZeneca) Erlotinib (Oncogene Science) Canertinib (Pfizer) Squalamine (Genaera) SU5416 (Pharmacia) SU6668 (Pharmacia) ZD4190 (AstraZeneca) ZD6474 (AstraZeneca) Vatalanib (Novartis) PKI166 (Novartis) GW2016 (GlaxoSmithKline) EKB-509 (Wyeth) EKB-569 (Wyeth)	Kahalide F (PharmaMar) CEP- 701 (Cephalon) CEP-751 (Cephalon) MLN518 (Millenium) PKC412 (Novartis) Phenoxodiol O Trastuzumab (Genentech) C225 (ImClone) rhu-Mab (Genentech) MDX-H210 (Medarex) 2C4 (Genentech) MDX-447 (Medarex) ABX-EGF (Abgenix) IMC-1C11 (ImClone)
20			
25	Various agents	SR-27897 (CCK-A inhibitor, Sanofi-Synthelabo) Tocladesine (cyclic AMP agonist, Ribapharm) Alvocidib (CDK inhibitor, Aventis) CV-247 (COX-2 inhibitor, Ivy Medical) P54 (COX-2 inhibitor, Phytopharm) CapCell™ (CYP450 stimula Bavarian Nordic) GCS-100 (gal3 antagonist, GlycoGenesys) G17DT immunogen (gastrin inhibitor, Aphton) Efaproxiral (oxygenator, Allos Therapeutics)	BCX-1777 (PNP inhibitor, BioCryst) Ranpirnase (ribonuclease stimulant, Alfacell) Galarubicin (RNA synthesis inhibitor, Dong-A) Tirapazamine (reducing agent, SRI International) N-Acetylcysteine (reducing agent, Zambon) R-Flurbiprofen (NF-kappaB inhibitor, Encore) 3CPA (NF-kappaB inhibitor, Active Biotech) Seocalcitol (vitamin D receptor agonist, Leo) 131-I-TM-601 (DNA
30			
35			

5	PI-88 (heparanase inhibitor, antagonist, TransMolecular Progen)	Eflornithin (ODC inhibitor, ILEX Oncology)
	Tesmilifen (histamine antagonist, YM BioSciences)	Minodronic acid (osteoclast inhibitor, Yamanouchi)
	Histamine (histamine H2 receptor agonist, Maxim)	Tiazofurin (IMPDH inhibitor, Ribapharm)
	Cilengitide (integrin antagonist, Merck KGaA)	Aplidin (PPT inhibitor, PharmaMar)
10	SR-31747 (IL-1 antagonist, Sanofi-Synthelabo)	Rituximab (CD20 antibody, Genentech)
	CCI-779 (mTOR kinase inhibitor, Wyeth)	Gemtuzumab (CD33 antibody, Wyeth Ayerst)
	Exisulind (PDE-V inhibitor, Cell Pathways)	PG2 (haematopoiesis promoter, Pharmagenesis)
15	CP-461 (PDE-V inhibitor, Cell Pathways)	Immunol TM (triclosan mouthwash, Endo)
	AG-2037 (GART inhibitor, Pfizer)	Triacetyluridine (uridine prodrug, Wellstat)
	WX-UK1 (plasminogen activator inhibitor, Willex)	SN-4071 (sarcoma agent, Signature BioScience)
20	PBI-1402 (PMN stimulant, ProMetic LifeSciences)	TransMID-107 TM (immunotoxin, KS Biomedix)
	Bortezomib (proteasome inhibitor, Millennium)	PCK-3145 (apoptosis promoter, Procyon)
	SRL-172 (T-cell stimulant, Schering-Plough)	Doranidazole (apoptosis promoter, Pola)
	TLK-286 (glutathione-S transferase inhibitor, Telik)	CHS-828 (cytotoxic agent, Leo)
25	PT-100 (growth factor agonist, Point Therapeutics)	Trans-retinic acid (differentiator, NIH)
	Midostaurin (PKC inhibitor, Novartis)	MX6 (apoptosis promoter, MAXIA)
	Bryostatin-1 (PKC stimulant, GPC Biotech)	Apomine (apoptosis promoter, ILEX Oncology)
30	CDA-II (apoptosis promoter, Everlife)	Urocidin (apoptosis promoter, Bioniche)
	SDX-101 (apoptosis promoter, Salmedix)	Ro-31-7453 (apoptosis promoter, La Roche)
	Ceflatonin (apoptosis promoter, ChemGenex)	Brostallicin (apoptosis promoter, Pharmacia)
35	Alkylating agents	Lomustin
	Cyclophosphamide	Procarbazine
	Busulfan	Altretamin
	Ifosfamide	

5		Melphalan Hexamethylmelamine Thiotepa Chloroambucil Dacarbazine Carmustine	Estramustine phosphate Mechloroethamin Streptozocin Temozolomid Semustin
10	Platinum agents	Cisplatin Oxaliplatin Spiroplatin Carboxyphthalatoplatinum Tetraplatin Ormiplatin Iproplatin	Carboplatin ZD-0473 (AnorMED) Lobaplatin (Aeterna) Satraplatin (Johnson Matthey) BBR-3464 (Hoffmann-La Roche) SM-11355 (Sumitomo) AP-5280 (Access)
15	Antimetabolites	Azacytidine Gemcitabine Capecitabine 5-Fluorouracil Floxuridine 2-Chlorodesoxyadenosine 6-Mercaptopurine 6-Thioguanine Cytarabine 2-Fluorodesoxycytidine Methotrexate Idatrexate	Tomudex Trimetrexate Deoxycoformycin Fludarabine Pentostatin Raltitrexed Hydroxyurea Decitabine (SuperGen) Clofarabine (Bioenvision) Irofulven (MGI Pharma) DMDC (Hoffmann-La Roche) Ethynylcytidine (Taiho)
25	Topoisomerase inhibitors	Amsacrine Epirubicin Etoposide Teniposide or mitoxantrone Irinotecan (CPT-11) 7-Ethyl-10-hydroxycamptothecin Topotecan Dexrazoxanet (TopoTarget) Pixantrone (Novuspharma) Rebeccamycin analogue (Exelixis) BBR-3576 (Novuspharma)	Rubitecan (SuperGen) Exatecan mesylate (Daiichi) Quinamed (ChemGenex) Gimatecan (Sigma- Tau) Diflomotecan (Beaufour- Ipsen) TAS-103 (Taiho) Elsamitrucin (Spectrum) J-107088 (Merck & Co) BNP-1350 (BioNumerik) CKD-602 (Chong Kun Dang) KW-2170 (Kyowa Hakko)
35	Antitumour antibiotics	Dactinomycin (Actinomycin D) Doxorubicin (Adriamycin)	Amonafide Azonafide Anthrapyrazole

5		Deoxyrubicin Valrubicin Daunorubicin (Daunomycin) Epirubicin Therarubicin Idarubicin Rubidazon Plicamycinp Porfiromycin Cyanomorpholinodoxorubici Mitoxantron (Novantron)	Oxantrazole Losoxantrone Bleomycin sulfate (Blenoxar) Bleomycinic acid Bleomycin A Bleomycin B Mitomycin C MEN-10755 (Menarini) GPX-100 (Gem Pharmaceuticals)
10	Antimitotic agents	Paclitaxel Docetaxel Colchicine Vinblastine Vincristine Vinorelbine Vindesine Dolastatin 10 (NCI) Rhizoxin (Fujisawa) Mivobulin (Warner-Lambert) Cemadotin (BASF) RPR 109881A (Aventis) TXD 258 (Aventis) Epothilone B (Novartis) T 900607 (Tularik) T 138067 (Tularik) Cryptophycin 52 (Eli Lilly) Vinflunine (Fabre) Auristatin PE (Teikoku Hormone) BMS 247550 (BMS) BMS 184476 (BMS) BMS 188797 (BMS) Taxoprexin (Protarga)	SB 408075 (GlaxoSmithKline) E7010 (Abbott) PG-TXL (Cell Therapeutics) IDN 5109 (Bayer) A 105972 (Abbott) A 204197 (Abbott) LU 223651 (BASF) D 24851 (ASTA Medica) ER-86526 (Eisai) Combretastatin A4 (BMS) Isohomohalichondrin-B (PharmaMar) ZD 6126 (AstraZeneca) PEG-Paclitaxel (Enzon) AZ10992 (Asahi) IDN-5109 (Indena) AVLB (Prescient NeuroPharma) Azaepothilon B (BMS) BNP- 7787 (BioNumerik) CA-4-prodrug (OXiGENE) Dolastatin-10 (NrH) CA-4 (OXiGENE)
30	Aromatase inhibitors	Aminoglutethimide Letrozole Anastrozole Formestan	Exemestan Atamestan (BioMedicines) YM-511 (Yamanouchi)
35	Thymidylate synthase inhibitors	Pemetrexed (Eli Lilly) ZD-9331 (BTG)	Nolatrexed (Eximias) CoFactor™ (BioKeys)
	DNA antagonists	Trabectedin (PharmaMar) Glufosfamide (Baxter)	Mafosfamide (Baxter International)

	International) Albumin + ³² P (Isotope Solutions) Thymectacin (NewBiotics) Edotreotid (Novartis)	Apaziquone (Spectrum Pharmaceuticals) O6-benzylguanine (Paligent)
5	Farnesyl transferase inhibitors	Arglabin (NuOncology Labs) lonafarnib (Schering-Plough Johnson) BAY-43-9006 (Bayer) Perillyl alcohol (DOR BioPharma)
10	Pump inhibitors	CBT-1 (CBA Pharma) Tariquidar (Xenova) MS-209 (Schering AG) Zosuquidar trihydrochloride (Eli Lilly) Biricodar dicitrate (Vertex)
15	Histone acetyl transferase inhibitors	Tacedinaline (Pfizer) SAHA (Aton Pharma) MS-275 (Schering AG) Pivaloyloxymethyl butyrate (Titan) Depsipeptide (Fujisawa)
	Metalloproteinase inhibitors Ribonucleoside reductase inhibitors	Neovastat (Aeterna Laboratories) Marimastat (British Biotech) Gallium maltolate (Titan) Triapin (Vion) CMT -3 (CollaGenex) BMS-275291 (Celltech) Tezacitabine (Aventis) Didox (Molecules for Health)
20	TNF-alpha agonists/antagon- ists	Virulizin (Lorus Therapeutics) CDC-394 (Celgene) Revimid (Celgene)
25	Endothelin-A receptor antagonists	Atrasentan (Abbot) ZD-4054 (AstraZeneca) YM-598 (Yamanouchi)
	Retinoic acid receptor agonists	Fenretinide (Johnson & Johnson) LGD-1550 (Ligand) Alitretinoin (Ligand)
30	Immunomodulators	Interferon Oncophage (Antigenics) GMK (Progenics) Adenocarcinoma vaccine (Biomira) CTP-37 (AVI BioPharma) JRX-2 (Immuno-Rx) PEP-005 (Peplin Biotech) Synchrovax vaccines (CTL Immuno) Dexosome therapy (Anosys) Pentrix (Australian Cancer Technology) JSF-154 (Tragen) Cancer vaccine (Intercell) Norelin (Biostar) BLP-25 (Biomira) MGV (Progenics) !3-Alethin (Dovetail) CLL-Thera (Vasogen)
35		

		Melanoma vaccine (CTL Immuno) p21-RAS vaccine (GemVax)	
5	Hormonal and antihormonal agents	Oestrogens Conjugated oestrogens Ethinyloestradiol Chlorotrianisene Idenestrol Hydroxyprogesterone caproate Medroxyprogesterone Testosterone Testosterone propionate Fluoxymesterone Methyltestosterone Diethylstilbestrol Megestrol Tamoxifen Toremofin Dexamethasone	Prednisone Methylprednisolone Prednisolone Aminoglutethimide Leuprolide Goserelin Leuporelin Bicalutamide Flutamide Octreotide Nilutamide Mitotan P-04 (Novogen) 2-Methoxyoestradiol (EntreMed) Arzoxifen (Eli Lilly)
10			
15			
20	Photodynamic agents	Talaporfin (Light Sciences) Theralux (Theratechnologies) Motexafin-Gadolinium (Pharmacyclics)	Pd-Bacteriopheophorbide (Yeda) Lutetium-Texaphyrin (Pharmacyclics) Hypericin
25	Tyrosine kinase inhibitors	Imatinib (Novartis) Leflunomide (Sugen/Pharmacia) ZD1839 (AstraZeneca) Erlotinib (Oncogene Sciences) Canertinib (Pfizer) Squalamine (Genaera) SU5416 (Pharmacia) SU6668 (Pharmacia) ZD4190 (AstraZeneca) ZD6474 (AstraZeneca) Vatalanib (Novartis) PKI166 (Novartis) GW2016 (GlaxoSmithKline) EKB-509 (Wyeth) EKB-569 (Wyeth)	Kahalide F (PharmaMar) CEP-701 (Cephalon) CEP-751 (Cephalon) MLN518 (Millenium) PKC412 (Novartis) Phenoxodiol O Trastuzumab (Genentech) C225 (ImClone) rhu-Mab (Genentech) MDX-H210 (Medarex) 2C4 (Genentech) MDX-447 (Medarex) ABX-EGF (Abgenix) IMC-1C11 (ImClone)
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35	Various agents	SR-27897 (CCK-A inhibitor, Sanofi-Synthelabo)	BCX-1777 (PNP inhibitor, BioCryst)

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Tocladesine (cyclic AMP agonist, Ribapharm)	Ranpirnase (ribonuclease stimulant, Alfacell)
Alvocidib (CDK inhibitor, Aventis)	Galarubicin (RNA synthesis inhibitor, Dong-A)
CV-247 (COX-2 inhibitor, Ivy Medical)	Tirapazamine (reducing agent, SRI International)
P54 (COX-2 inhibitor, Phytopharm)	N-Acetylcysteine (reducing agent, Zambon)
CapCell™ (CYP450 stimulant, Bavarian Nordic)	R-Flurbiprofen (NF-kappaB inhibitor, Encore)
GCS-100 (gal3 antagonist, GlycoGenesys)	3CPA (NF-kappaB inhibitor, Active Biotech)
G17DT immunogen (gastrin inhibitor, Aphton)	Seocalcitol (vitamin D receptor agonist, Leo)
Efaproxiral (oxygenator, All Therapeutics)	131-I-TM-601 (DNA antagonist, TransMolecular)
PI-88 (heparanase inhibitor, Progen)	Eflornithin (ODC inhibitor, IL Oncology)
Tesmilifen (histamine antagonist, YM BioSciences)	Minodronic acid (osteoclast inhibitor, Yamanouchi)
Histamine (histamine H2 receptor agonist, Maxim)	Indisulam (p53 stimulant, Eisai)
Tiazofurin (IMPDH inhibitor, Ribapharm)	Aplidin (PPT inhibitor, PharmaMar)
Cilengitide (integrin antagonist, Merck KGaA)	Rituximab (CD20 antibody, Genentech)
SR-31747 (IL-1 antagonist, Sanofi-Synthelabo)	Gemtuzumab (CD33 antibody, Wyeth Ayerst)
CCI-779 (mTOR kinase inhibitor, Wyeth)	PG2 (haematopoiesis promoter, Pharmagenesis)
Exisulind (PDE-V inhibitor, Pathways)	Immunol™ (triclosan mouthwash, Endo)
CP-461 (PDE-V inhibitor, Pathways)	Triacetyluridine (uridine prodrug, Wellstat)
AG-2037 (GART inhibitor, Pfizer)	SN-4071 (sarcoma agent, Signature BioScience)
WX-UK1 (plasminogen activator inhibitor, Willex)	TransMID-107™ (immunotoxin, KS Biomedix)
PBI-1402 (PMN stimulant, ProMetic LifeSciences)	PCK-3145 (apoptosis promoter, Procyon)
Bortezomib (proteasome inhibitor, Millennium)	Doranidazole (apoptosis promoter, Pola)
SRL-172 (T-cell stimulant, SR Pharma)	CHS-828 (cytotoxic agent, Leo)
TLK-286 (glutathione-S	Trans-retinic acid

5	transferase inhibitor, Telik) (differentiator, NIH) PT-100 (growth factor agoni MX6 (apoptosis promoter, Point Therapeutics) MAXIA) Midostaurin (PKC inhibitor, Apomine (apoptosis promot Novartis) ILEX Oncology) Bryostatin-1 (PKC stimulant Urocidin (apoptosis promote GPC Biotech) Bioniche) CDA-II (apoptosis promoter, Ro-31-7453 (apoptosis Everlife) promoter, La Roche) SDX-101 (apoptosis Brostallicin (apoptosis promoter, Salmedix) promoter, Pharmacia) Ceflatonin (apoptosis promoter, ChemGenex)
10	

A combined treatment of this type can be achieved with the aid of simulta-
 neous, consecutive or separate dispensing of the individual components of
 the treatment. Combination products of this type employ the compounds
 according to the invention.

ASSAYS

The compounds of the formula I described in the examples were tested by
 the assays described below and were found to have kinase inhibitory
 activity. Other assays are known from the literature and could readily be
 performed by the person skilled in the art (see, for example, Dhanabal et
 al., *Cancer Res.* 59:189-197; Xin et al., *J. Biol. Chem.* 274:9116-9121;
 Sheu et al., *Anticancer Res.* 18:4435-4441; Ausprunk et al., *Dev. Biol.*
 38:237-248; Gimbrone et al., *J. Natl. Cancer Inst.* 52:413-427; Nicosia et
 al., *In Vitro* 18:538- 549).

Measurement of Met kinase activity

According to the manufacturer's data (Met, active, Upstate, catalogue No.
 14-526), Met kinase is expressed for the purposes of protein production in
 insect cells (Sf21; *S. frugiperda*) and subsequent affinity-chromatographic

purification as "N-terminal 6His-tagged" recombinant human protein in a baculovirus expression vector.

5 The kinase activity can be measured using various available measurement systems. In the scintillation proximity method (Sorg et al., J. of Biomolecular Screening, 2002, 7, 11-19), the flashplate method or the filter binding test, the radioactive phosphorylation of a protein or peptide as substrate is measured using radioactively labelled ATP (^{32}P -ATP, ^{33}P -ATP). In the
10 case of the presence of an inhibitory compound, a reduced radioactive signal, or none at all, can be detected. Furthermore, homogeneous time-resolved fluorescence resonance energy transfer (HTR-FRET) and fluorescence polarisation (FP) technologies can be used as assay methods
15 (Sills et al., J. of Biomolecular Screening, 2002, 191-214).

Other non-radioactive ELISA assay methods use specific phospho antibodies (phospho-ABs). The phospho antibody only binds the phosphorylated substrate. This binding can be detected by chemiluminescence
20 using a second peroxidase-conjugated antibody (Ross et al., 2002, Biochem. J.).

Flashplate method (Met kinase)

25 The test plates used are 96-well Flashplate^R microtitre plates from Perkin Elmer (Cat. No. SMP200). The components of the kinase reaction described below are pipetted into the assay plate. The Met kinase and the substrate poly Ala-Glu-Lys-Tyr, (pAGLT, 6:2:5:1), are incubated for 3 hrs at room temperature with radioactively labelled ^{33}P -ATP in the presence and
30 absence of test substances in a total volume of 100 μl . The reaction is terminated using 150 μl of a 60 mM EDTA solution. After incubation for a further 30 min at room temperature, the supernatants are filtered off with suction, and the wells are washed three times with 200 μl of 0.9% NaCl
35 solution each time. The measurement of the bound radioactivity is carried

out by means of a scintillation measuring instrument (Topcount NXT, Perkin-Elmer).

5 The full value used is the inhibitor-free kinase reaction. This should be approximately in the range 6000-9000 cpm. The pharmacological zero value used is staurosporin in a final concentration of 0.1 mM. The inhibitory values (IC₅₀) are determined using the RS1_MTS program.

Kinase reaction conditions per well:

10 30 µl of assay buffer
10 µl of substance to be tested in assay buffer with 10% of DMSO
10 µl of ATP (final concentration 1 µM cold, 0.35 µCi of ³³P-ATP)
50 µl of Met kinase/substrate mixture in assay buffer;
15 (10 ng of enzyme/well, 50 ng of pAGLT/well)

Solutions used:

- Assay buffer:
20 50 mM HEPES
3 mM magnesium chloride
3 µM sodium orthovanadate
3 mM manganese(II) chloride
1 mM dithiothreitol (DTT)
pH = 7.5 (to be set using sodium hydroxide)
- 25 - Stop solution:
60 mM Titriplex III (EDTA)
- ³³P-ATP: Perkin-Elmer;
- 30 - Met kinase: Upstate, Cat. No. 14-526, Stock 1 µg/10 µl; spec. activity 954 U/mg;
- Poly-Ala-Glu-Lys-Tyr, 6 : 2 : 5 : 1 : Sigma Cat. No. P1152

35 Above and below, all temperatures are indicated in °C. In the following examples, "conventional work-up" means: water is added if necessary, the

pH is adjusted, if necessary, to values between 2 and 10, depending on the constitution of the end product, the mixture is extracted with ethyl acetate or dichloromethane, the phases are separated, the organic phase is dried over sodium sulfate and evaporated, and the residue is purified by chromatography on silica gel and/or by crystallisation. Rf values on silica gel; eluent: ethyl acetate/methanol 9:1.

Melting point m.p. in °C;

Mass spectrometry (MS): EI (electron impact ionisation) M^+

FAB (fast atom bombardment) $(M+H)^+$

ESI (electrospray ionisation) $(M+H)^+$

APCI-MS (atmospheric pressure chemical ionisation - mass spectrometry) $(M+H)^+$.

HPLC method:

Flow rate: 2 ml/min

99:01 - 0:100 water + 0.1%(vol.) of TFA : acetonitrile + 0.1%(vol.) of TFA

0.0 to 0.2 min: 99:01

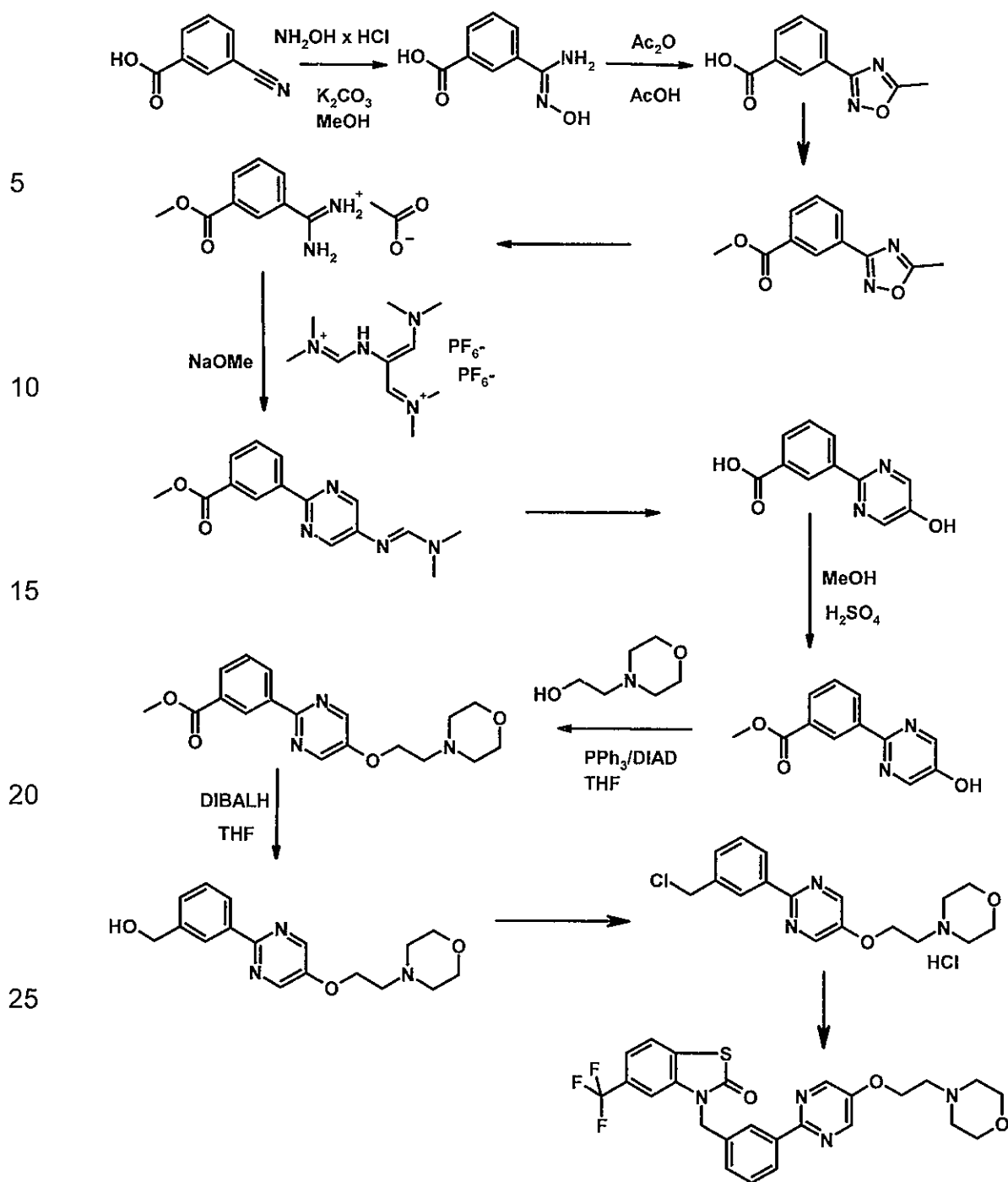
0.2 to 3.8 min: 99:01---> 0:100

3.8 to 4.2 min: 0:100

Column: Chromolith Performance RP18e; 100 mm long, internal diameter 3 mm, wavelength: 220 nm

Example 1

The preparation of 3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A1") is carried out analogously to the following scheme



Step 1:

Preparation of 3-(N-hydroxycarbamimidoyl)benzoic acid:

1382 g (10.0 mol) of potassium carbonate are added in portions with stirring to a suspension, kept at 30°C, of 500 g (3.40 mol) of 3-cyanobenzoic acid in 8 l of methanol. 695 g (10.0 mol) of hydroxylammonium chloride are subsequently added in small portions at an internal temperature of 40 – 45°C. The

reaction mixture is then heated at the boil for 15 hours. The reaction mixture is evaporated in vacuo, the residue is dissolved in water and acidified using 37% aqueous hydrochloric acid. The precipitate formed is filtered off with suction, washed with water and dried in vacuo: 3-(N-hydroxycarbamimidoyl)-benzoic acid as colourless crystals; m.p. 208°; ESI 181 (M+H).

Step 2:

Preparation of 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoic acid:

A mixture of 614 g (3.41 mol) of 3-(N-hydroxycarbamimidoyl)benzoic acid, 756 ml (8.0 mol) of acetic anhydride and 2 l of acetic acid is heated at a temperature of 118°C for 14 hours. The reaction mixture is cooled to 6°C and filtered off with suction. The residue is taken up in 2 l of water, filtered off with suction and washed well with water. The residue is recrystallised from ethanol/water: 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoic acid as colourless crystals; m.p. 225° ; ESI 205 (M+H).

Step 3:

Preparation of methyl 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoate:

7.83 ml (147 mmol) of concentrated sulfuric acid are added to a suspension of 30.0 g (147 mmol) of 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoic acid in 150 ml of methanol, and the mixture is heated at the boil for 18 hours. The reaction mixture is cooled in an ice bath, water is added, the mixture is filtered off with suction and washed well with water: methyl 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoate as colourless crystals; m.p. 81°C, ESI 219 (M+H), HPLC: Rt. = 2.65 min (method A).

Step 4:

Preparation of methyl 3-carbamimidoylbenzoate acetate:

150 ml of acetic acid, 150 ml of water and 50 g of water-moist Raney nickel are added to a solution of 327 g (1.47 mol) of methyl 3-(5-methyl-1,2,4-

oxadiazol-3-yl)benzoate in 3 l of methanol, and the mixture is hydrogenated at room temperature and atmospheric pressure for 18 hours. The catalyst is filtered off, and the filtrate is evaporated. The residue is taken up in *tert*-butyl methyl ether, heated to the boil and filtered off with suction. The residue is dried in vacuo: 3-methoxycarbonylbenzamidine acetate as colourless crystals; m.p. 222°; ESI 179 (M+H); HPLC: Rt. = 1.40 min (method A).

Step 5:

Preparation of methyl 3-[5-(dimethylaminomethyleneamino)pyrimidin-2-yl]benzoate:

2.2 l of a freshly prepared 1.5 M sodium methoxide solution are added dropwise with stirring to a suspension of 259 g (1.09 mol) of 3-methoxycarbonylbenzamidine acetate and 528 g (1.08 mol) of ({2-dimethylamino-1-[dimethylimmoniomethyl]vinylamino}methylene)dimethylammonium dihexafluorophosphate ("aminoreductone precursor", prepared in accordance with C. B. Dousson et al., Synthesis 2005, 1817) in 1 l of methanol. The reaction mixture is then warmed to 60°C over the course of 40 min and kept at this temperature for 30 min. The reaction mixture is then cooled to room temperature, diluted with 10 l of dichloromethane and washed three times with 5 l of water each time. The organic phase is dried over sodium sulfate and evaporated. The residue is recrystallised from ethyl acetate: methyl 3-[5-(dimethylaminomethyleneamino)pyrimidin-2-yl]benzoate as beige crystals; m.p. 146°C, ESI 285 (M+H), HPLC: Rt. = 2.03 min (method A).

Step 6:

Preparation of 3-(5-hydroxypyrimidin-2-yl)benzoic acid:

160 ml (2.88 mol) of concentrated sulfuric acid are added to a suspension of 103.5 g (364 mmol) of methyl 3-[5-(dimethylaminomethyleneamino)pyrimidin-2-yl]benzoate in 1.3 l of water, and the mixture is heated at the boil for 4 hours. The reaction mixture is cooled to room temperature, diluted with water and filtered off with suction. The residue is washed with water and

dried in vacuo: 3-(5-hydroxypyrimidin-2-yl)benzoic acid as brownish crystals; m.p. 293-295°; ESI 217 (M+H); HPLC: Rt. = 2.19 min (method A).

5 Step 7:

Preparation of methyl 3-(5-hydroxypyrimidin-2-yl)benzoate:

32.7 ml (445 mmol) of thionyl chloride are added to a suspension of 88.0 g (366 mmol) of 3-(5-hydroxypyrimidin-2-yl)benzoic acid in 1.4 l of methanol, and the mixture is heated at 80°C for 2 hours. 20 ml (276 mmol) of thionyl chloride and, after 2 hours, a further 10 ml (138 mmol) of thionyl chloride are then added. After each addition, the reaction mixture is stirred at 80°C for 2 hours. The reaction mixture is evaporated to a volume of about 300 ml in vacuo. The precipitate formed is filtered off and dried in vacuo: methyl 3-(5-hydroxypyrimidin-2-yl)benzoate as brownish crystals; m.p. 219-223°; ESI 231 (M+H); HPLC: Rt. = 2.58 min (method A).

20 Step 8:

Preparation of methyl 3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzoate:

A solution, kept under nitrogen, of 10.1 g (44 mmol) of methyl 3-(5-hydroxypyrimidin-2-yl)benzoate, 17.3 g (66 mmol) of triphenylphosphine and 5.9 ml (48.4 mmol) of 2-morpholin-4-ylethanol in 100 ml of THF is cooled in an ice bath, and 12.95 ml (66 mmol) of diisopropyl azodicarboxylate are slowly added dropwise with stirring. After stirring at room temperature for 2 hours, the reaction mixture is evaporated in vacuo. The residue is taken up in 100 ml of dichloromethane and 100 ml of water. The organic phase is dried over sodium sulfate and evaporated. The residue is recrystallised from isopropanol: methyl 3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzoate as beige crystals; m.p. 89-91°; ESI 344 (M+H); HPLC: 2.06 min (method A).

35 Step 9:

Preparation of {3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]phenyl}methanol:

138 ml of a 1 M solution of diisobutylaluminium hydride in THF are added dropwise with stirring to a solution, kept under nitrogen, of 9.5 g (27.5 mmol) of methyl 3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzoate in 180 ml of THF. After the mixture has been stirred at room temperature for 1 hour,
5 100 ml of a saturated aqueous ammonium chloride solution are added dropwise. The precipitate formed is filtered off with suction and washed a number of times with dichloromethane. The filtrate is dried over sodium sulfate and evaporated. The residue is recrystallised from a mixture of
10 isopropanol/ether: {3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]phenyl}-methanol as yellow crystals; m.p. 101-102°; ESI 316 (M+H); HPLC: Rt. = 1.67 min (method A).

15 Step 10: Preparation of 4-{2-[2-(3-chloromethylphenyl)pyrimidin-5-yloxy]-ethyl}morpholine hydrochloride:

6 ml of thionyl chloride are added to 1 g (3.17 mmol) of {3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]phenyl}methanol, and the mixture is stirred at room
20 temperature for 30 min. The thionyl chloride was distilled off, co-evaporated 3 times with toluene and reacted further directly without further purification: 4-{2-[2-(3-chloromethylphenyl)pyrimidin-5-yloxy]ethyl}morpholine hydro-
chloride; pale-yellow crystals, m.p. 183-184°, HPLC: Rt. = 2.18 min (method
25 A)

Step 11:

Preparation of 3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A1"):

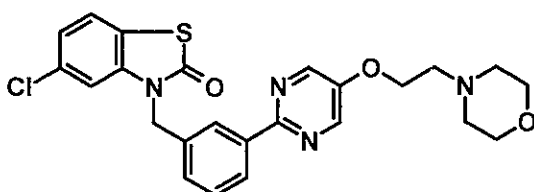
30 A suspension of 89 mg (0.405 mmol) of 5-trifluoromethyl-3H-benzothiazol-2-one, 150 mg (0.405 mmol) of 4-{2-[2-(3-chloromethylphenyl)pyrimidin-5-yloxy]ethyl}morpholine hydrochloride and 286 mg (2.02 mmol) of potassium carbonate in 8 ml of acetonitrile are stirred at 70°C for 5 days. 30 ml of water
35 are added to the reaction mixture, with a precipitate slowly forming. The precipitate is filtered off with suction, washed with water and dried.

Product: ESI: 517 (M+H); Rt. = 2.72 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 8.64 (s, 2H), 8.28 (s, 1H), 8.22 (d, J = 7.8, 1H), 7.96 (d, J = 8.2, 1H), 7.69 (s, 1H), 7.56 (d, J = 8.2, 1H), 7.49 (t, J = 7.7, 1H), 7.42 (d, J = 7.6, 1H), 5.40 (s, 2H), 4.30 (t, J = 5.6, 2H), 3.61 – 3.53 (m, 4H), 2.73 (t, J = 5.6, 2H), 2.49 (m, superimposed, 4H).

The following compounds are obtained analogously:

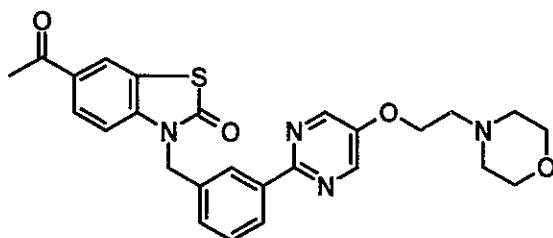
5-Chloro-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one ("A2")



ESI: 483 (M+H); Rt. = 2.65 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 8.65 (s, 2H), 8.25 (s, 1H), 8.22 (d, J = 7.9, 1H), 7.74 (d, J = 8.4, 1H), 7.49 (dd, J = 4.8, 10.3, 2H), 7.41 (d, J = 7.7, 1H), 7.26 (dd, J = 1.9, 8.4, 1H), 5.31 (s, 2H), 4.30 (t, J = 5.6, 2H), 3.63 – 3.50 (m, 4H), 2.73 (t, J = 5.6, 2H), 2.49 (m, superimposed, 4H).

6-Acetyl-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one ("A3")



ESI: 505 (M+H); Rt. = 2.70 min (method A);

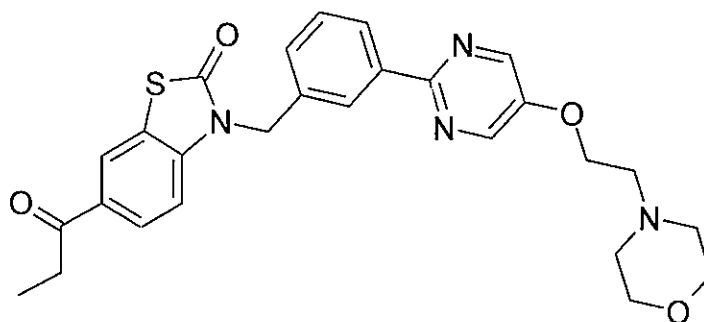
¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 10.20 (b, 1H), 8.68 (s, 2H), 8.36 (d, J = 1.7, 1H), 8.23 (d, J = 9.2, 2H), 7.93 (dd, J = 1.8, 8.6, 1H), 7.54 – 7.35 (m, 3H), 5.34 (s, 2H), 4.57 (s, 2H), 3.0-4.1 (m, 10H), 3.01 (q, J = 7.2, 2H), 1.07 (t, J = 7.2, 3H).

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3-{3-[5-(2-Morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-6-propionyl-3H-benzothiazol-2-one ("A3a")

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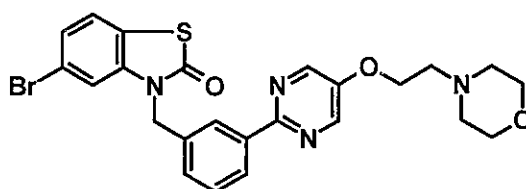
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5-Bromo-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one ("A4")

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25



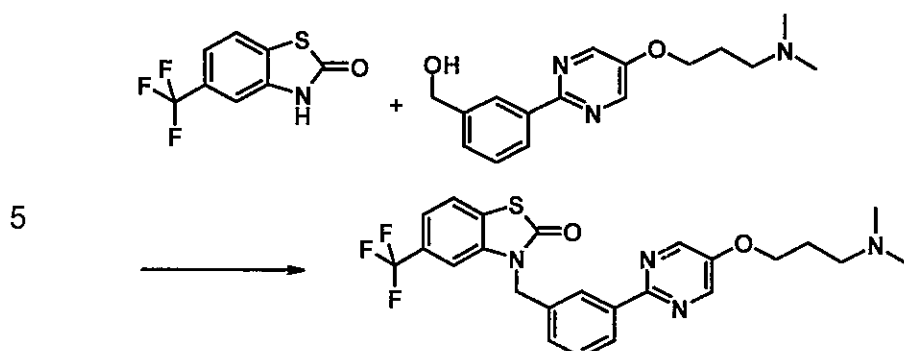
ESI: 527/529 (M+H), Rt. = 2.79 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 10.05 (b, 1H), 8.70 (s, 2H), 8.24 (d, J = 6.3, 2H), 7.69 (d, J = 8.4, 1H), 7.59 (d, J = 1.8, 1H), 7.49-7.55 (m, 1H), 7.45 (d, J = 7.6, 1H), 7.40 (dd, J = 1.9, 8.4, 1H), 5.32 (s, 2H), 4.57 (b, 2H), 2.99-3.99 (m, 10H).

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Preparation of 3-{3-[5-(3-dimethylaminopropoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A5"):

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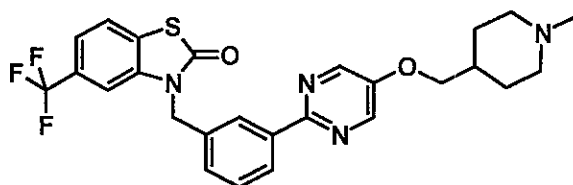


A suspension of 114 mg (0.52 mmol) of 5-trifluoromethyl-3H-benzothiazol-2-one, 150 mg (0.52 mmol) of {3-[5-(3-dimethylaminopropoxy)pyrimidin-2-yl]phenyl}methanol and 261 mg (0.78 mmol) of polymer-bound triphenylphosphine (3mmol/g) is shaken at room temperature for 30 min. 178 mg (0.78 mmol) of di-*tert*-butyl azodicarboxylate are added to the suspension, and, after the mixture has been stirred at room temperature for 24 h, 50 mg (0.15 mmol) of polymer-bound triphenylphosphine (3mmol/g) and 35 mg (0.15 mmol) of di-*tert*-butyl azodicarboxylate are again present and shaken at room temperature for 2 h. The reaction mixture is filtered, the filtrate is evaporated to dryness, and the residue is purified by means of preparative HPLC. The product is in the form of the trifluoroacetate; ESI: 489 (M+H); Rt. = 2.81 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 9.43 (s, 1H), 8.64 (s, 2H), 8.27 (s, 1H), 8.23 (d, *J* = 7.7, 1H), 7.97 (d, *J* = 8.2, 1H), 7.69 (s, 1H), 7.56 (d, *J* = 8.2, 1H), 7.50 (t, *J* = 7.7, 1H), 7.45 (d, *J* = 7.7, 1H), 5.40 (s, 2H), 4.27 (t, *J* = 6.0, 2H), 3.24 (s, 2H), 2.83 (d, *J* = 3.4, 6H), 2.22 – 2.10 (m, 2H).

The following compounds are obtained analogously

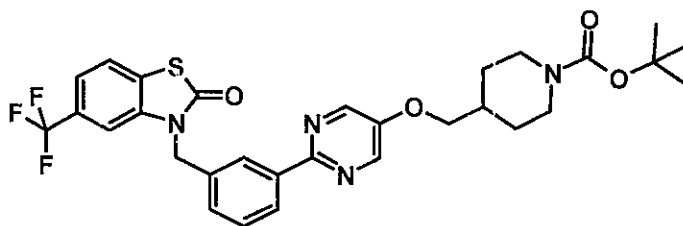
3-{3-[5-(1-Methylpiperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A6")



ESI: 515 (M+H); Rt. = 2.92 min (method A);

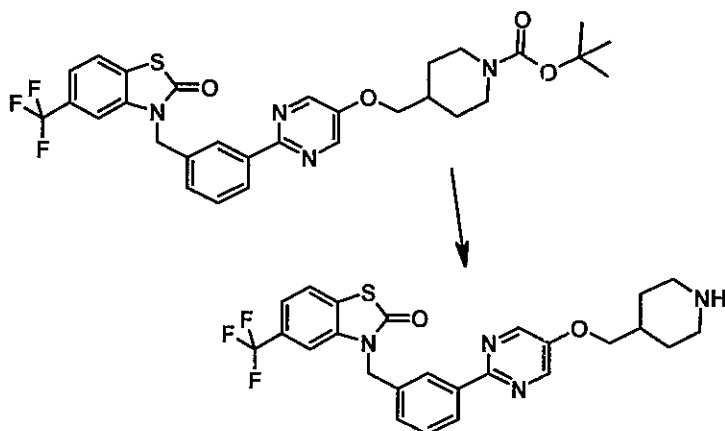
¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 8.62 (s, 2H), 8.28 (s, 1H), 8.22 (d, J = 7.8, 1H), 7.96 (d, J = 8.2, 1H), 7.69 (s, 1H), 7.55 (d, J = 8.2, 1H), 7.48 (t, J = 7.7, 1H), 7.42 (d, J = 7.6, 1H), 5.40 (s, 2H), 4.05 (d, J = 6.0, 2H), 2.84 (d, J = 11.2, 2H), 2.21 (s, 3H), 1.97 (s, 2H), 1.76 (d, J = 9.6, 3H), 1.43 – 1.27 (m, 2H).

3-{3-[5-(1-tert-Butoxycarbonylpiperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A7")



ESI: 545 (M – *tert*-butyl + H); Rt. = 3.95 min (method A).

Preparation of 3-{3-[5-(piperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one ("A8")

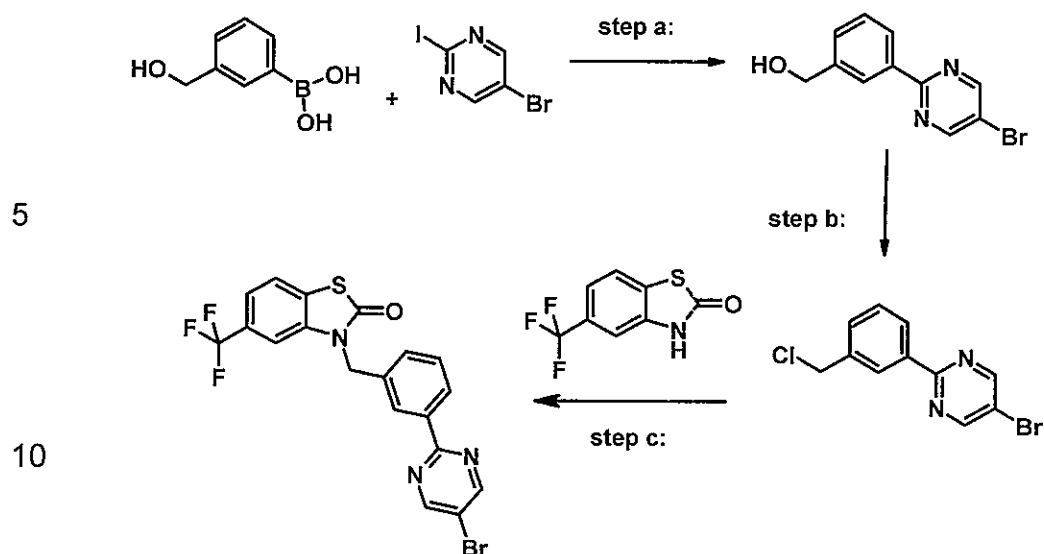


424 mg (0.64 mmol) of 3-{3-[5-(1-tert-butoxycarbonylpiperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one is dissolved in 20 ml of dioxane, and 6 ml of 4N HCl in dioxane are added. The mixture is stirred at room temperature for 24 h. A viscous precipitate forms in the process, which is filtered off with suction and stirred with isopropanol.

ESI: 501 (M+H); Rt. = 2.87 min (method A);

^1H NMR (500 MHz, DMSO- d_6) δ [ppm] 8.92 (s, 1H), 8.65 (d, J = 15.2, 3H), 8.26 (s, 1H), 8.22 (d, J = 7.8, 1H), 7.96 (d, J = 8.2, 1H), 7.67 (s, 1H), 7.56 (d, J = 8.2, 1H), 7.50 (t, J = 7.7, 1H), 7.43 (d, J = 7.7, 1H), 5.39 (s, 2H), 4.09 (d, J = 6.4, 2H), 3.30 (d, J = 12.5, 2H), 2.90 (d, J = 10.8, 2H), 2.12 (s, 1H), 1.93 (d, J = 12.3, 2H), 1.52 (d, J = 10.4, 2H).

Preparation of 3-[3-(5-bromopyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one ("A9a"):



Step a:

Preparation of [3-(5-bromopyrimidin-2-yl)phenyl]methanol:

750 mg (0.65 mmol) of tetrakis(triphenylphosphine)palladium are added to a solution, kept under nitrogen, of 6.11 g (21.5 mmol) of 5-bromo-2-iodopyrimidine, 3.91 g (25.7 mmol) of 3-(hydroxymethyl)benzeneboronic acid and 9.11 g (42.9 mmol) of tripotassium phosphate trihydrate in 120 ml of dioxane and 14 ml of water, and the mixture is stirred at 90°C for 18 hours. The reaction mixture is cooled to room temperature, *tert*-butyl methyl ether and water are added, and the mixture is filtered through kieselguhr. The organic phase of the filtrate is separated off, dried over sodium sulfate and evaporated. The residue is chromatographed on a silica-gel column with dichloromethane/methanol as eluent; product: 2.49 g; m.p. 114-117°; ESI: 265, 267 (M+H); HPLC: Rt. = 2.51 min (method A).

Step b:

Preparation of 5-bromo-2-(3-chloromethylphenyl)pyrimidine:

80 g (302 mmol) of [3-(5-bromopyrimidin-2-yl)phenyl]methanol are suspended in 300 ml of dichloromethane, and 33 ml (453 mmol) of thionyl chloride are slowly added with cooling. The reaction mixture is stirred at room tem-

perature for 3 h. The solvent is distilled off, co-evaporated 3 times with toluene and stirred with diethyl ether;
pale-yellow crystals, m.p. 146-148°; HPLC: Rt. = 3.15 min (method A).

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Step c:

Preparation of 3-[3-(5-bromopyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one:

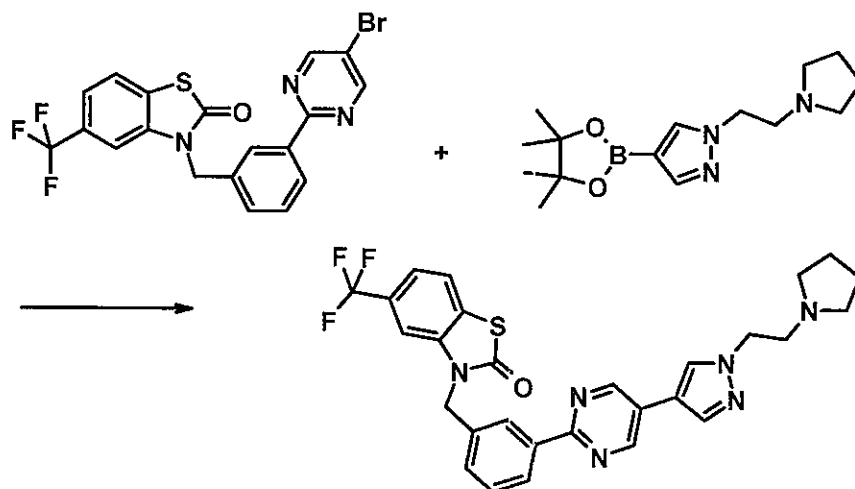
10 1 g (4.56 mmol) of 5-trifluoromethyl-3H-benzothiazol-2-one, 1.3 g (4.56 mmol) of 5-bromo-2-(3-chloromethylphenyl)pyrimidine and 4.5 g (13.69 mmol) of caesium carbonates are suspended in 15 ml of DMF and stirred at room temperature for 15 h and at 80°C for 3 h. The suspension is added to water, and the precipitate is filtered off with suction, washed with methanol and dried in vacuo, giving beige crystals; HPLC: Rt. = 3.72 min (method A);

15 ¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 9.08 (s, 2H), 8.35 (s, 1H), 8.29 (d, J = 6.9, 1H), 7.98 (d, J = 8.2, 1H), 7.72 (s, 1H), 7.47-7.63 (m, 3H), 5.43 (s, 2H).

20

Preparation of 3-(3-{5-[1-(2-pyrrolidin-1-ylethyl)-1H-pyrazol-4-yl]pyrimidin-2-yl}benzyl)-5-trifluoromethyl-3H-benzothiazol-2-one ("A9")

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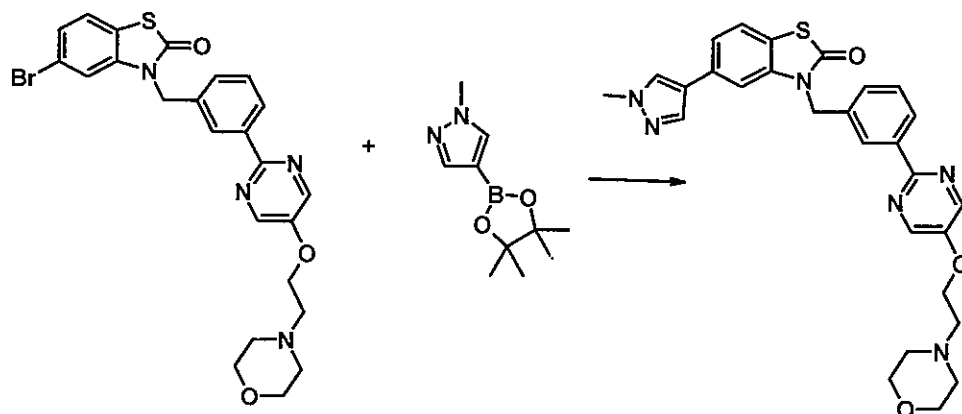


212 mg (1.0 mmol) of tripotassium phosphate trihydrate and 28 mg
(0.04 mmol) of bis(triphenylphosphine)palladium chloride are added to a
solution, kept under nitrogen, of 233 mg (0.50 mmol) of 3-[3-(5-bromo-
pyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one and 229 mg
(1.10 mmol) of 1-(2-pyrrolidin-1-ylethyl)-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrazoline in 10 ml of 1,2-dimethoxyethane, and the mixture is stirred at 80°C for 18 hours. 28 mg (0.04 mmol) of bis(triphenylphosphine)palladium chloride is added a further twice each time, and the mixture is stirred at 80°C for 24 hours in each case. The reaction mixture is diluted with water, extracted with ethyl acetate, dried and evaporated. The crude product is purified by means of column chromatography on silica gel (dichloromethane / methanol).

ESI: 550 (M+H); HPLC: 2.70 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 9.17 (s, 2H), 8.50 (s, 1H), 8.43 (s, 1H), 8.38 (d, *J* = 7.0, 1H), 8.23 (s, 1H), 7.93 (d, *J* = 8.1, 1H), 7.70 (s, 1H), 7.47-7.59 (m, 3H), 5.45 (s, 2H), 4.62 (t, *J* = 6.0, 2H), 3.77 (t, *J* = 6.1, 2H), 3.68 – 3.55 (m, 2H), 3.16 – 3.03 (m, 2H), 2.11 – 1.99 (m, 2H), 1.98 – 1.83 (m, 2H).

Preparation of 5-(1-methyl-1H-pyrazol-4-yl)-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one ("A10"):

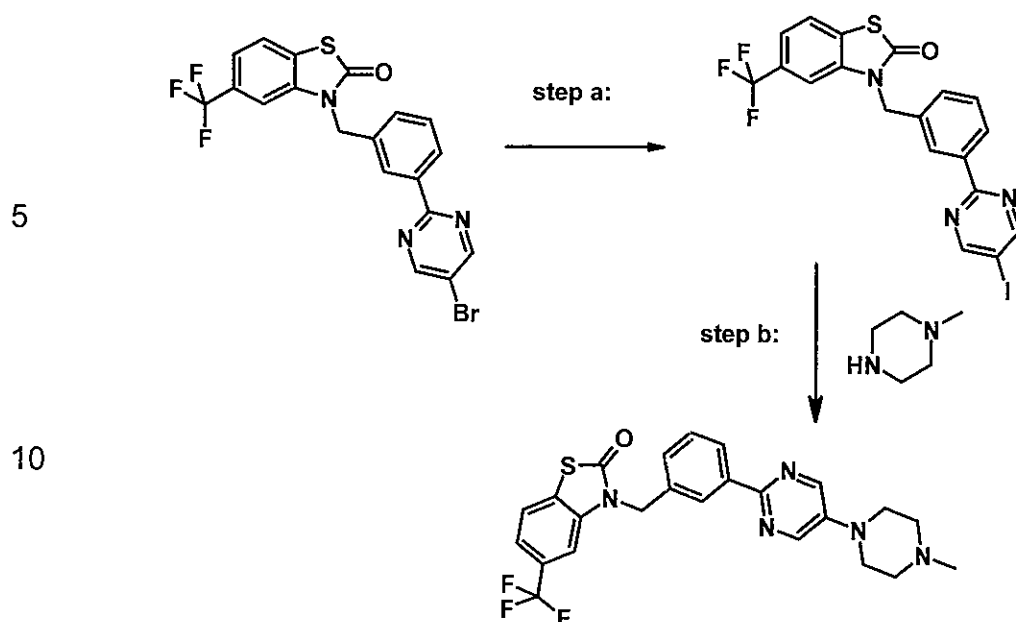


65 mg (0.30 mmol) of tripotassium phosphate trihydrate and 9 mg
(0.01 mmol) of bis(triphenylphosphine)palladium chloride are added to a
solution, kept under nitrogen, of 122 mg (0.15 mmol) of 5-bromo-3-{3-[5-(2-
morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one and 35
mg (0.15 mmol) of 1-methyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-
1H-pyrazoles in 4 ml of 1,2-dimethoxyethane, and the mixture is stirred at
80°C for 18 hours. 9 mg (0.01 mmol) of bis(triphenylphosphine)palladium
chloride is added a further twice each time, and the mixture is stirred at
80°C for 24 hours in each case. The reaction mixture is diluted with water,
extracted with ethyl acetate, dried and evaporated. The crude product is
purified by means of preparative HPLC. The product is in the form of the
trifluoroacetate.

ESI: 529 (M+H); HPLC: 2.32 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 9.95 (b, 1H), 8.69 (s, 2H), 8.30 (s,
1H), 8.22 (d, *J* = 7.3, 1H), 8.14 (s, 1H), 7.88 (s, 1H), 7.64 (d, *J* = 8.2, 1H),
7.57 (d, *J* = 1.4, 1H), 7.55 – 7.45 (m, *J* = 1.6, 8.2, 2H), 7.40 (dd, 1H), 5.34
(s, 2H), 4.56 (s, 2H), 2.99-3.99 (m, 10H), 3.84 (s, 3H).

Preparation of 3-{3-[5-(4-methylpiperazin-1-yl)pyrimidin-2-yl]benzyl}-5-
trifluoromethyl-3H-benzothiazol-2-one ("A11"):



15

Step a:

933 mg (2 mmol) of 3-[3-(5-bromopyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one is suspended in 10 ml of dioxane, and 660 mg (4.4 mmol) of sodium iodide and 19 mg (0.1 mmol) of copper(I) iodide are added. 35 μ l (0.22 mmol) of trans-N,N-dimethyl-1,2-cyclohexanediamine were added, and the mixture is refluxed under argon for 48h. A further 35 μ l (0.22 mmol) of trans-N,N-dimethyl-1,2-cyclohexanediamine and 19 mg (0.1 mmol) of copper(I) iodide are added, and the reaction mixture is refluxed for 3 days.

20

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The reaction mixture is stirred into water, the precipitate is filtered off with suction, and the residue is dried in vacuo.

ESI: 514 (M+H); HPLC: 3.72 min (method A).

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Step b:

513 mg (1 mmol) of 3-[3-(5-iodopyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one is suspended in toluene, briefly heated to 100°C and cooled to room temperature. 134 μ l (1.2 mmol) of methylpiperazine, 297 mg (1.4 mmol) of potassium phosphate trihydrate, and 33 mg

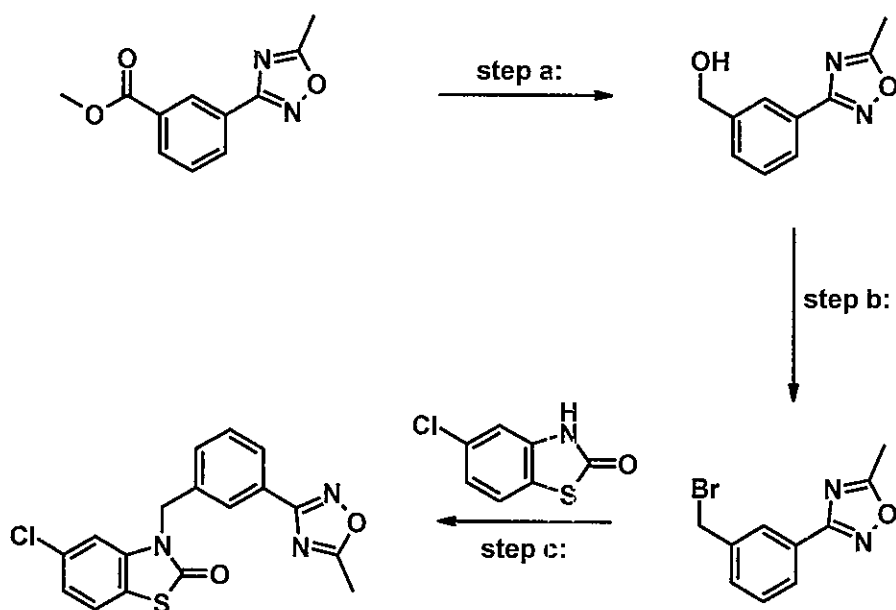
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(0.08 mmol) of 2-dicyclohexylphosphino-2',6'-dimethoxybiphenyl and 18 mg (0.02 mmol) of tris(benzylideneacetone)dipalladium are subsequently added and stirred at 100°C under an argon atmosphere. 33 mg (0.08 mmol) of 2-dicyclohexylphosphino-2',6'-dimethoxybiphenyl and 18 mg (0.02 mmol) of tris(benzylideneacetone)dipalladium are subsequently again added and stirred at 100°C for a further 24 h under an argon atmosphere. Water is added to the reaction mixture, which is then extracted with ethyl acetate and dried. The crude product is purified by means of preparative HPLC. The product is in the form of the trifluoroacetate.

ESI: 486 (M+H); HPLC: 2.53 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] 8.58 (s, 2H), 8.24 (s, 1H), 8.19 (d, J = 7.9, 1H), 7.98 (d, J = 8.2, 1H), 7.69 (s, 1H), 7.57 (d, J = 8.2, 1H), 7.46 (t, J = 7.7, 1H), 7.38 (d, J = 7.7, 1H), 5.40 (s, 2H), 3.3 and 2.5 (superimposed, 8H) 2.27 (s, 3H).

Preparation of 5-chloro-3-[3-(5-methyl-1,2,4-oxadiazol-3-yl)benzyl]-3H-benzothiazol-2-one ("A12")



Step a:

50.9 g (233 mmol) of methyl 3-(5-methyl-1,2,4-oxadiazol-3-yl)benzoate are
5 dissolved in 500 ml of THF, and 5.6 g (256 mmol) of lithium borohydride
are added in portions with stirring at 0°C. The reaction mixture is stirred at
room temperature for 20 h and subsequently adjusted to a pH of 7 using
1 N HCl. The mixture is diluted with 500 ml of water and extracted with
10 3 x 500 ml of dichloromethane. The combined organic phases are washed
with water, dried and purified by column chromatography on silica gel.
ESI: 191 (M+H); m.p. 42°.

Step b:

15 9.83 g (51.7 mmol) of [3-(5-methyl-1,2,4-oxadiazol-3-yl)phenyl]methanol
are dissolved in 150 ml of toluene; heated to 35°C, and 4.91 mol
(52 mmol) of phosphorus tribromide, dissolved in toluene, are then added
dropwise. The batch is stirred at 35°C for 1 h and at RT for 2 h. The batch
20 is stirred into ice-water. It is extracted three times with ethyl acetate. The
organic phase is dried and evaporated. The crude product is purified by
column chromatography on silica gel (PE/EA; 9:1), giving white crystals,
m.p. 64°, ESI: 254 (M+H).

Step c:

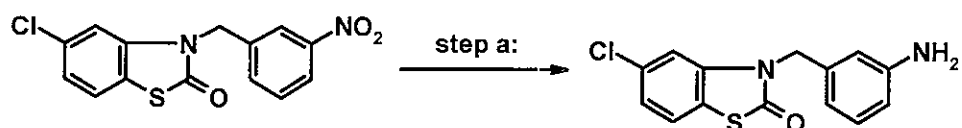
A suspension of 100 mg (0.54 mmol) of 5-chloro-3H-benzothiazol-2-one,
153 mg (0.59 mmol) of 3-(3-bromomethylphenyl)-5-methyl-1,2,4-oxa-
30 diazole and 303 mg (2.16 mmol) of potassium carbonate in 20 ml of aceto-
nitrile are stirred at 80°C for 1 h. 30 ml of water are added to the reaction
mixture, which is then extracted with MTBE, dried and evaporated to dry-
ness. The crude product is purified by column chromatography on silica gel
35 and stirred with ether, giving "A12": ESI: 358 (M+H); Rt. = 3.25 min
(method A);

^1H NMR (500 MHz, DMSO- d_6) δ [ppm] 7.97 (s, 1H), 7.93 (d, $J = 7.6$, 1H), 7.75 (d, $J = 8.4$, 1H), 7.57 (t, $J = 7.6$, 1H), 7.52 (m, 2H), 7.28 (dd, $J = 2.0$, 8.4, 1H), 5.33 (s, 2H), 2.66 (s, 3H).

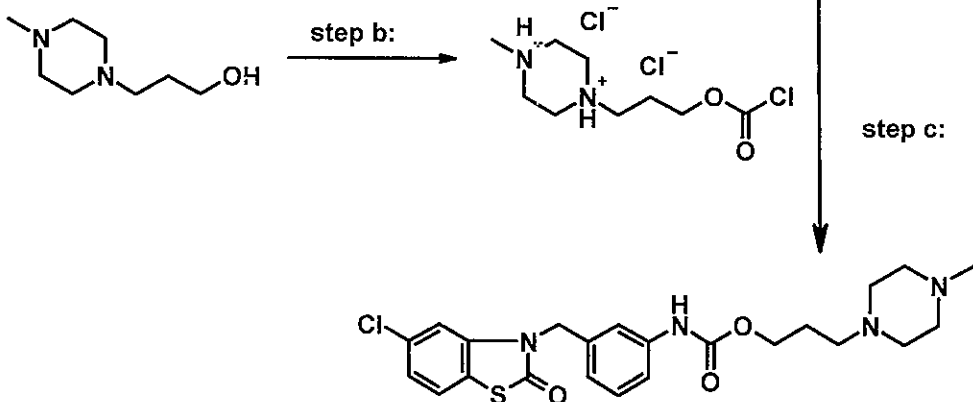
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Preparation of 3-(4-methylpiperazin-1-yl)propyl [3-(5-chloro-2-oxobenzothiazol-3-ylmethyl)phenyl]carbamate ("A13"):

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Step a:

25

4.5 g (12.8 mol) of 5-chloro-3-(3-nitrobenzyl)-3H-benzothiazol-2-one ["A13a"; prepared analogously to "A12"; ESI: 321 (M+H); Rt. = 3.20 min (method A)] are dissolved in 100 ml of THF and hydrogenated under a hydrogen atmosphere at room temperature using 2 g of palladium on active carbon (water-moist, 5% of Pd). After 24 h, the catalyst is filtered off with suction, rinsed with THF and evaporated, giving 3-(3-aminobenzyl)-5-chloro-3H-benzothiazol-2-one, ESI: 291 (M+H); HPLC: Rt. = 2.28 min (method A).

35

Step b:

4.775 g (30 mmol) of 3-(4-methylpiperazin-1-yl)propan-1-ol are dissolved in 20 ml of dioxane, 20 ml of 4 N HCl in dioxane are added, and the mixture is evaporated to dryness. This residue is triturated in MTBE, filtered off with suction and dried. This solid (6.7 g) is suspended in 50 ml of acetonitrile, and 6 g (30 mmol) of trichloromethyl chloroformate, dissolved in 10 ml of acetonitrile, are added at 0°. The mixture is stirred at room temperature for a further 48 h. The reaction mixture is filtered off with suction, washed with acetonitrile and dried, giving a white solid, m.p. 248-250° (decomposition).

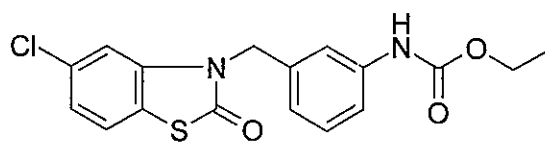
Step c:

173 mg (0.36 mmol) of 3-(3-aminobenzyl)-5-chloro-3H-benzothiazol-2-one and 198 mg (0.67 mmol) of 3-(4-methylpiperazin-1-yl)propane 1-chloroformate are suspended in 3 ml of THF, and 253 µl (1.46 mmol) of DIPEA are added. The reaction mixture is stirred overnight at room temperature. 50ml of dichloromethane are added to the suspension, which is subsequently washed with 10ml of 2N NaOH, dried and evaporated. The crude product is purified by means of preparative HPLC. The product "A13" is in the form of the trifluoroacetate.

ESI: 475 (M+H); HPLC: Rt. = 2.43 min (method A);

¹H NMR (500 MHz, DMSO-d₆) δ [ppm] δ 9.61 (s, 1H), 9.48 – 8.86 (b, 1H), 7.74 (d, J = 8.4, 1H), 7.39 (d, J = 8.1, 1H), 7.34 (s, 2H), 7.23-7.30 (m, 2H), 6.97 (d, J = 7.5, 1H), 5.16 (s, 2H), 4.09 (m, 2H), 2.45-3.50 (superimposed, 13H), 1.81 (b, 2H).

Reaction of 3-(3-aminobenzyl)-5-chloro-3H-benzothiazol-2-one with ethyl formate gives ethyl [3-(5-chloro-2-oxobenzothiazol-3-ylmethyl)phenyl]carbamate ("A14")

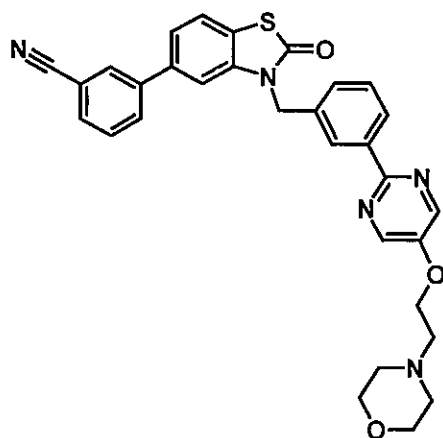


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The following compounds are obtained analogously to the procedures given above

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"A15":



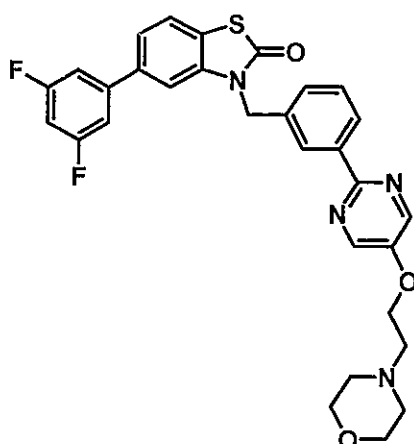
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20

ESI: 550 (M+H);

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"A16":



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ESI: 561 (M+H).

Pharmacological data

5

Met kinase inhibition (enzyme assay)

Table 1

10

15

20

25

Compound No.	IC ₅₀
"A1"	A
"A2"	A
"A3"	A
"A3a"	A
"A4"	A
"A5"	A
"A6"	A
"A7"	A
"A8"	A
"A9"	A
"A10"	A
"A11"	A
"A12"	A
"A13"	A
"A14"	A

IC₅₀: 10 nM - 1 μ M = A1 μ M - 10 μ M = B

30

> 10 μ M = C

35

The following examples relate to medicaments:

5

Example A: Injection vials

10

A solution of 100 g of an active ingredient of the formula I and 5 g of disodium hydrogenphosphate in 3 l of bidistilled water is adjusted to pH 6.5 using 2 N hydrochloric acid, sterile filtered, transferred into injection vials, lyophilised under sterile conditions and sealed under sterile conditions. Each injection vial contains 5 mg of active ingredient.

15

Example B: Suppositories

20

A mixture of 20 g of an active ingredient of the formula I with 100 g of soya lecithin and 1400 g of cocoa butter is melted, poured into moulds and allowed to cool. Each suppository contains 20 mg of active ingredient.

Example C: Solution

25

A solution is prepared from 1 g of an active ingredient of the formula I, 9.38 g of $\text{NaH}_2\text{PO}_4 \cdot 2 \text{H}_2\text{O}$, 28.48 g of $\text{Na}_2\text{HPO}_4 \cdot 12 \text{H}_2\text{O}$ and 0.1 g of benzalkonium chloride in 940 ml of bidistilled water. The pH is adjusted to 6.8, and the solution is made up to 1 l and sterilised by irradiation. This solution can be used in the form of eye drops.

30

Example D: Ointment

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500 mg of an active ingredient of the formula I are mixed with 99.5 g of Vaseline under aseptic conditions.

Example E: Tablets

5 A mixture of 1 kg of active ingredient of the formula I, 4 kg of lactose, 1.2 kg of potato starch, 0.2 kg of talc and 0.1 kg of magnesium stearate is pressed in a conventional manner to give tablets in such a way that each tablet contains 10 mg of active ingredient.

Example F: Dragees

10 Tablets are pressed analogously to Example E and subsequently coated in a conventional manner with a coating of sucrose, potato starch, talc, tragacanth and dye.

15

Example G: Capsules

20 2 kg of active ingredient of the formula I are introduced into hard gelatine capsules in a conventional manner in such a way that each capsule contains 20 mg of the active ingredient.

Example H: Ampoules

25 A solution of 1 kg of active ingredient of the formula I in 60 l of bidistilled water is sterile filtered, transferred into ampoules, lyophilised under sterile conditions and sealed under sterile conditions. Each ampoule contains 10 mg of active ingredient.

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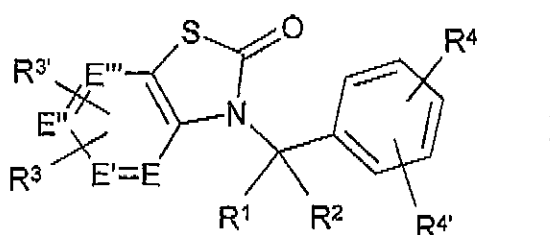
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Patent Claims

1. Compounds of the formula I

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10



in which

E, E', E'', E''' each, independently of one another, denote C or N,

R¹, R² each, independently of one another, denote H or A,

15 R¹ and R² together also denote (CH₂)_p, in which 1 or 2 CH₂ group(s) may be replaced by O and/or NH,

R³ denotes A, COA, (CH₂)_nHet, Hal, O(CH₂)_mNAA' or O(CH₂)_mHet,

20 Z denotes CR⁶(NR⁶)₂CR⁶(OR⁶)A,

R^{3'} denotes H or Hal,

R⁴ denotes Het¹, NHCOOR⁵, NHCONHR⁵, NHCOCONHR⁵, NO₂ or NHCOA,

R^{4'} denotes H or Hal,

25 R⁴ and R^{4'} together also denote NHCONH,

R⁵ denotes A, (CH₂)_mNH₂, (CH₂)_mNHA, (CH₂)_mNAA' or (CH₂)_mHet,

30 Ar denotes phenyl, naphthyl or biphenyl, each of which is unsubstituted or mono-, di- or trisubstituted by Hal, A, OH, OA, N(R⁶)₂, SR⁶, NO₂, CN, COOR⁶, CON(R⁶)₂, NR⁶COA, NR⁶SO₂A, SO₂N(R⁶)₂, S(O)_mA, CO-Het¹, [C(R⁶)₂]_nN(R⁶)₂, [C(R⁶)₂]_nHet¹, O[C(R⁶)₂]_pN(R⁶)₂, O[C(R⁶)₂]_nHet¹, NHCOOA, NHCON(R⁶)₂, NHCOO[C(R⁶)₂]_pN(R⁶)₂, NHCOO[C(R⁶)₂]_n.

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		Het ¹ , NHCONH[C(R ⁶) ₂] _p N(R ³) ₂ , NHCONH[C(R ⁶) ₂] _n Het ¹ , OCONH[C(R ⁶) ₂] _p N(R ⁶) ₂ and/or OCONH[C(R ⁶) ₂] _n Het ¹ ,
5	Het	denotes a mono- or bicyclic saturated, unsaturated or aromatic heterocycle having 1 to 4 N, O and/or S atoms, which is unsubstituted or may be mono-, di- or trisubstituted by Hal, A, OR ⁶ , N(R ⁶) ₂ , NO ₂ , CN, COOR ⁶ , CON(R ⁶) ₂ , NR ³ COA, NR ⁶ SO ₂ A, SO ₂ N(R ⁶) ₂ , S(O) _m A, NHCOOA, NHCON(R ⁶) ₂ , CHO, COA, =S, =NH, =NA and/or =O (carbonyl oxygen),
10	Het ¹	denotes a monocyclic aromatic heterocycle having 1 to 4 N, O and/or S atoms, which is unsubstituted or may be mono-, di- or trisubstituted, in each case independently of one another, by R ³ ,
15	R ⁶	denotes H or A,
	A, A'	each, independently of one another, denote unbranched or branched alkyl having 1-10 C atoms,
20		in which 1-7 H atoms may be replaced by F, Cl and/or Br,
		and/or in which one or two CH ₂ groups may be replaced by O, S, SO, SO ₂ and/or CH=CH groups,
25		or
	Cyc	cyclic alkyl having 3-7 C atoms,
	Hal	denotes F, Cl, Br or I,
	m	denotes 1, 2, 3 or 4,
30	n	denotes 0, 1, 2, 3 or 4,
	p	denotes 1, 2, 3, 4 or 5,
	q	denotes 1, 2, 3, 4 or 5,
35		and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

2. Compounds according to Claim 1 in which

A, A' each, independently of one another, denotes unbranched or branched alkyl having 1-10 C atoms,
in which 1-7 H atoms may be replaced by F and/or
Cl,

5

and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

10

3. Compounds according to one or more of Claims 1-2 in which
Het denotes a monocyclic saturated, unsaturated or aromatic heterocycle having 1 to 3 N, O and/or S atoms, which is unsubstituted or may be mono- or disubstituted by A and/or COOR⁶,

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and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

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4. Compounds according to one or more of Claims 1-3 in which
Het denotes piperidinyl, pyrrolidinyl, morpholin-4-yl, piperazinyl, 1,3-oxazolidin-3-yl, imidazolidinyl, oxazolyl, oxadiazolyl, thiazolyl, thienyl, furanyl or pyridyl,
where the radicals may also be mono- or disubstituted by A and/or COOR⁶,

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and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

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5. Compounds according to one or more of Claims 1-4 in which
E, E', E'', E''' denote C,
and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

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6. Compounds according to one or more of Claims 1-5 in which
R¹, R² denote H,

and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

- 5 7. Compounds according to one or more of Claims 1-6 in which
 $R^{3'}$ denotes H,
 and pharmaceutically usable salts, tautomers and stereoisomers
 thereof, including mixtures thereof in all ratios.
- 10 8. Compounds according to one or more of Claims 1-7 in which
 R^4 denotes Het¹, NHCOOR⁵ or NO₂,
 and pharmaceutically usable salts, tautomers and stereoisomers
 thereof, including mixtures thereof in all ratios.
- 15 9. Compounds according to one or more of Claims 1-8 in which
 $R^{4'}$ denotes H,
 and pharmaceutically usable salts, tautomers and stereoisomers
20 thereof, including mixtures thereof in all ratios.
10. Compounds according to one or more of Claims 1-9 in which
 R^5 denotes (CH₂)_mHet,
 and pharmaceutically usable salts, tautomers and stereoisomers
25 thereof, including mixtures thereof in all ratios.
11. Compounds according to one or more of Claims 1-10 in which
 R^6 denotes H, methyl, ethyl, propyl, isopropyl, butyl or tert-
30 butyl,
 and pharmaceutically usable salts, tautomers and stereoisomers
 thereof, including mixtures thereof in all ratios.
- 35 12. Compounds according to one or more of Claims 1-11 in which
 Het¹ denotes 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-,
 2, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-

5 oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4-
or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimi-
diny, 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or
5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-
oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-
thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-
pyridazinyl or pyrazinyl, which are unsubstituted or mono-
or disubstituted by A, $O(CH_2)_mNH_2$, $O(CH_2)_mNHA$,
10 $O(CH_2)_mNAA'$, Het, OHet, $N=CH-NAA'$,
 $N=CH-NHA$, $N=CH-NH_2$ and/or $O(CH_2)_mHet$,
and pharmaceutically usable salts, tautomers and stereoisomers
thereof, including mixtures thereof in all ratios.

- 15 13. Compounds according to one or more of Claims 1-13 in which
E, E', E'', E''' denote C,
 R^1, R^2 denote H,
20 R^3 denotes A, COA, $(CH_2)_nHet$, Hal, $O(CH_2)_mNAA'$ or
 $O(CH_2)_mHet$,
 $R^{3'}$ denotes H,
 R^4 denotes Het¹, $NHCOOR^5$ or NO_2 ,
 $R^{4'}$ denotes H,
25 R^5 denotes $(CH_2)_mHet$,
Ar denotes phenyl which is mono-, di- or trisubstituted by Hal
and/or CN,
Het denotes piperidiny, pyrrolidiny, morpholin-4-yl, piper-
30 ziny, 1,3-oxazolidin-3-yl, imidazolidiny, oxazolyl, oxadia-
zoly, thiazolyl, thienyl, furanyl or pyridyl,
where the radicals may also be mono- or disubstituted by
A and/or $COOR^6$,
35 Het¹ denotes 2- or 3-furyl, 2- or 3-thienyl, 1-, 2- or 3-pyrrolyl, 1-,
2-, 4- or 5-imidazolyl, 1-, 3-, 4- or 5-pyrazolyl, 2-, 4- or 5-
oxazolyl, 3-, 4- or 5-isoxazolyl, 2-, 4- or 5-thiazolyl, 3-, 4-

or 5-isothiazolyl, 2-, 3- or 4-pyridyl, 2-, 4-, 5- or 6-pyrimidinyl, 1,2,3-triazol-1-, -4- or -5-yl, 1,2,4-triazol-1-, -3- or 5-yl, 1- or 5-tetrazolyl, 1,2,3-oxadiazol-4- or -5-yl, 1,2,4-oxadiazol-3- or -5-yl, 1,3,4-thiadiazol-2- or -5-yl, 1,2,4-thiadiazol-3- or -5-yl, 1,2,3-thiadiazol-4- or -5-yl, 3- or 4-pyridazinyl or pyrazinyl, which are unsubstituted or mono- or disubstituted by A, $O(CH_2)_mNH_2$, $O(CH_2)_mNHA$, $O(CH_2)_mNAA'$, Het, OHet, $N=CH-NAA'$, $N=CH-NHA$, $N=CH-NH_2$ and/or $O(CH_2)_mHet$,
 R^6 denotes H, methyl, ethyl, propyl, isopropyl, butyl or tert-butyl,
A, A' each, independently of one another, denote unbranched or branched alkyl having 1-10 C atoms,
in which 1-7 H atoms may be replaced by F and/or Cl,
Hal denotes F, Cl, Br or I,
m denotes 1, 2, 3 or 4,
and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

14. Compounds according to Claim 1, selected from the group

No.	Structure and/or name
"A1"	3-{3-[5-(2-Morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A2"	5-Chloro-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one
"A3"	6-Acetyl-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one
"A3a"	3-{3-[5-(2-Morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-6-propionyl-3H-benzothiazol-2-one

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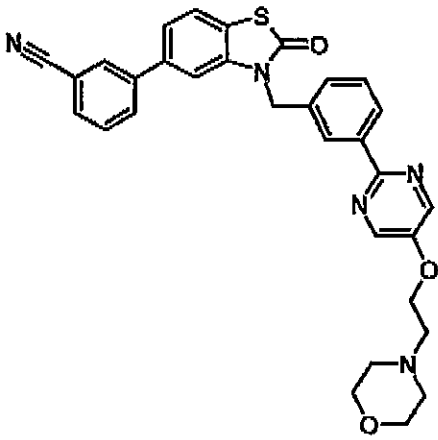
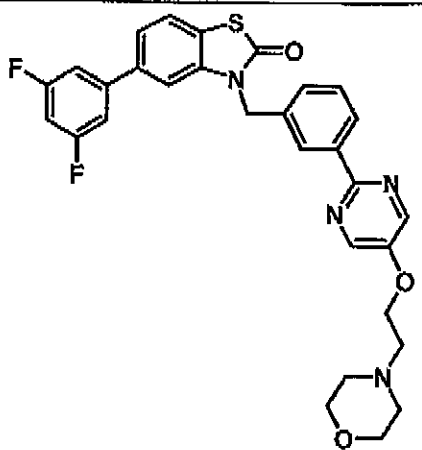
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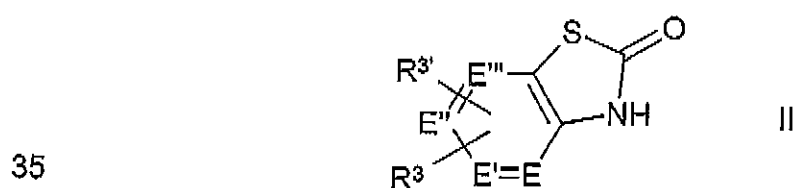
"A4"	5-Bromo-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]-benzyl}-3H-benzothiazol-2-one
"A5"	3-{3-[5-(3-Dimethylaminopropoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A6"	3-{3-[5-(1-Methylpiperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A7"	3-{3-[5-(1-tert-Butoxycarbonylpiperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A8"	3-{3-[5-(Piperidin-4-ylmethoxy)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A9"	3-(3-{5-[1-(2-Pyrrolidin-1-ylethyl)-1H-pyrazol-4-yl]pyrimidin-2-yl}benzyl)-5-trifluoromethyl-3H-benzothiazol-2-one
"A9a"	3-[3-(5-Bromopyrimidin-2-yl)benzyl]-5-trifluoromethyl-3H-benzothiazol-2-one
"A10"	5-(1-Methyl-1H-pyrazol-4-yl)-3-{3-[5-(2-morpholin-4-ylethoxy)pyrimidin-2-yl]benzyl}-3H-benzothiazol-2-one
"A11"	3-{3-[5-(4-Methylpiperazin-1-yl)pyrimidin-2-yl]benzyl}-5-trifluoromethyl-3H-benzothiazol-2-one
"A12"	5-Chloro-3-[3-(5-methyl-1,2,4-oxadiazol-3-yl)benzyl]-3H-benzothiazol-2-one
"A13"	3-(4-Methylpiperazin-1-yl)propyl [3-(5-chloro-2-oxo-benzothiazol-3-ylmethyl)phenyl]carbamate
"A14"	Ethyl [3-(5-chloro-2-oxobenzothiazol-3-ylmethyl)phenyl]-carbamate

5	"A15"	
10		
15	"A16"	
20		

and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios.

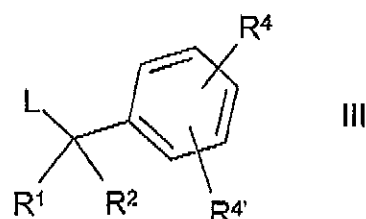
- 25 15. Process for the preparation of compounds of the formula I according to Claims 1-14 and pharmaceutically usable salts, tautomers and stereoisomers thereof, characterised in that

- 30 a) a compound of the formula II



in which E, E', E'', E''', R³ and R^{3'} have the meanings indicated in Claim 1,

is reacted with a compound of the formula III



in which R¹, R², R⁴ and R^{4'} have the meanings indicated in Claim 1 and L denotes Cl, Br, I or a free or reactively functionally modified OH group,

and/or

a base or acid of the formula I is converted into one of its salts.

16. Medicaments comprising at least one compound of the formula I according to Claim 1-14 and/or pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios, and optionally excipients and/or adjuvants.

17. Use of compounds according to Claim 1-14 and pharmaceutically usable salts, tautomers and stereoisomers thereof, including mixtures thereof in all ratios, for the preparation of a medicament for the treatment of diseases, where the disease to be treated is a solid tumour or a tumour of the blood and immune system.