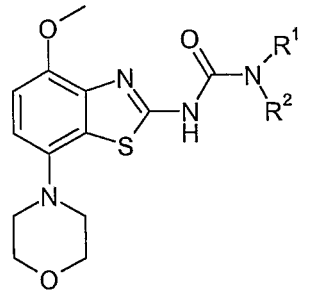
BENZOTHIAZOLE DERIVATIVES AND USE THEREOF IN THE TREATMENT OF DISEASES RELATED TO THE ADENOSINE A2A RECEPTOR

The present invention relates to compounds of the general formula



I

wherein

R^1 is $C_{5,6}$-cycloalkyl, substituted by CF_3, lower alkyl, $-(CH_2)_nOH$ or $-(CH_2)_n$-O-lower alkyl, or is
1-bicyclo[2.2.1]hept-2-yl,
1-(7-oxa-bicyclo[2.2.1]hept-2-yl,
1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-exo-yl,
1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl,
or is 1-adamantan-1-yl;

R^2 is lower alkyl; or

R^1 and R^2 form together with the N-atom the group 8-oxa-3-aza-bicyclo[3.2.1]octane;

n is 0 or 1;

and to pharmaceutically acceptable acid addition salts thereof.

It has surprisingly been found that the compounds of general formula I are adenosine receptor ligands. Specifically, the compounds of the present invention have a good affinity to the A_{2A}-receptor and a high selectivity to the A_1- and A_3 receptors.

Adenosine modulates a wide range of physiological functions by interacting with specific cell surface receptors. The potential of adenosine receptors as drug targets was first reviewed in 1982. Adenosine is related both structurally and metabolically to the bioactive nucleotides adenosine triphosphate (ATP), adenosine diphosphate (ADP),

adenosine monophosphate (AMP) and cyclic adenosine monophosphate (cAMP); to the biochemical methylating agent S-adenosyl-L-methione (SAM); and structurally to the coenzymes NAD, FAD and coenzym A; and to RNA. Together adenosine and these related compounds are important in the regulation of many aspects of cellular metabolism and in the modulation of different central nervous system activities.

The receptores for adenosine have been classified as A_1, A_{2A}, A_{2B} and A_3 receptors, belonging to the family of G protein-coupled receptors. Activation of adenosine receptors by adenosine initiates signal transduction mechanism. These mechanisms are dependent on the receptor associated G protein. Each of the adenosine receptor subtyps has been classically characterised by the adenylate cyclase effector system, which utilises cAMP as a second messenger. The A_1 and A_3 receptors, coupled with G_i proteins inhibit adenylate cyclase, leading to a decrease in cellular cAMP levels, while A_{2A} and A_{2B} receptors couple to G_s proteins and activate adenylate cyclase, leading to an increase in cellular cAMP levels. It is known that the A_1 receptor system include the activation of phospholipase C and modulation of both potassium and calcium ion channels. The A_3 subtype, in addition to its association with adenylate cyclase, also stimulates phospholipase C and so activates calcium ion channels.

The A_1 receptor (326-328 amino acids) was cloned from various species (canine, human, rat, dog, chick, bovine, guinea-pig) with 90–95 % sequence identify among the mammalian species. The A_{2A} receptor (409-412 amino acids) was cloned from canine, rat, human, guinea pig and mouse. The A_{2B} receptor (332 amino acids) was cloned from human and mouse with 45 % homology of human A_{2B} with human A_1 and A_{2A} receptors. The A_3 receptor (317-320 amino acids) was cloned from human, rat, dog, rabbit and sheep.

The A_1 and A_{2A} receptor subtypes are proposed to play complementary roles in adenosine's regulation of the energy supply. Adenosine, which is a metabolic product of ATP, diffuses from the cell and acts locally to activate adenosine receptors to decrease the oxygen demand (A_1) or increase the oxygen supply (A_{2A}) and so reinstate the balance of energy supply: demand within the tissue. The actions of both subtyps is to increase the amount of available oxygen to tissue and to protect cells against damage caused by a short term imbalance of oxygen. One of the important functions of endogenous adenosine is preventing damage during traumas such as hypoxia, ischaemia, hypotension and seizure activity.

Furthermore, it is known that the binding of the adenosine receptor agonist to mast cells expressing the rat A_3 receptor resulted in increased inositol triphosphate and intracellular calcium concentrations, which potentiated antigen induced secretion of inflammatory mediators. Therefore, the A_3 receptor plays a role in mediating asthmatic attacks and other allergic responses.

Adenosine is a neuromodulator, able to modulate many aspects of physiological brain function. Endogenous adenosine, a central link between energy metabolism and neuronal activity, varies according to behavioural state and (patho)physiological conditions. Under conditions of increased demand and decreased availability of energy (such as hypoxia, hypoglycemia, and/or excessive neuronal activity), adenosine provides a powerful protective fedback mechanism. Interacting with adenosine receptors represents a promising target for therapeutic intervention in a number of neurological and psychiatric diseases such as epilepsy, sleep, movement disorders (Parkinson or Huntington's disease), Alzheimer's disease, depression, schizophrenia, or addiction An increase in neurotransmitter release follows traumas such as hypoxia, ischaemia and seizures. These neurotransmitters are ultimately responsible for neural degeneration and neural death, which causes brain damage or death of the individual. The adenosine A_1 agonists which mimic the central inhibitory effects of adenosine may therefore be useful as neuroprotective agents. Adenosine has been proposed as an endogenous anticonvulsant agent, inhibiting glutamate release from excitory neurons and inhibiting neuronal firing. Adenosine agonists therefore may be used as antiepileptic agents. Adenosine antagonists stimulate the activity of the CNS and have proven to be effective as cognition enhancers. Selective A_{2a} antagonists have therapeutic potential in the treatment of various forms of dementia, for example in Alzheimer's disease, and of neurodegenerative disorders, e.g. stroke. Adenosine A_{2a} receptor antagonists modulate the activity of striatal GABAergic neurons and regulate smooth and well-coordinated movements, thus offering a potential therapy for Parkinsonian symptoms. Adenosine is also implicated in a number of physiological processes involved in sedation, hypnosis, schizophrenia, anxiety, pain, respiration, depression, and drug addiction (amphetamine, cocaine, opioids, ethanol, nicotine, cannabinoids). Drugs acting at adenosine receptors therefore have therapeutic potential as sedatives, muscle relaxants, antipsychotics, anxiolytics, analgesics, respiratory stimulants, antidepressants, and to treat drug abuse. They may also be used in the treatment of ADHD (attention deficit hyper-activity disorder).

An important role for adenosine in the cardiovascular system is as a cardioprotective agent. Levels of endogenous adenosine increase in response to ischaemia and hypoxia, and protect cardiac tissue during and after trauma (preconditioning). By acting at the A_1 receptor, adenosine A_1 agonists may protect against the injury caused by myocardial ischemia and reperfusion. The modulating influence of A_{2a} receptors on adrenergic function may have implications for a variety of disorders such as coronary artery disease and heart failure. A_{2a} antagonists may be of therapeutic benefit in situations in which an enhanced antiadrenergic response is desirable, such as during acute myocardial ischemia. Selective antagonists at A_{2a} receptors may also enhance the effectiveness of adenosine in terminating supraventricula arrhytmias.

Adenosine modulates many aspects of renal function, including renin release, glomerular filtration rate and renal blood flow. Compounds which antagonise the renal affects of adenosine have potential as renal protective agents. Furthermore, adenosine A_3 and/or A_{2B} antagonists may be useful in the treatment of asthma and other allergic responses or and in the treament of diabetes mellitus and obesity.

Numerous documents describe the current knowledge on adenosine receptors, for example the following publications:

Bioorganic & Medicinal Chemistry, 6, (1998), 619-641,
Bioorganic & Medicinal Chemistry, 6, (1998), 707-719,
J. Med. Chem., (1998), 41, 2835-2845,
J. Med. Chem., (1998), 41, 3186-3201,
J. Med. Chem., (1998), 41, 2126-2133,
J. Med. Chem., (1999), 42, 706-721,
J. Med. Chem., (1996), 39, 1164-1171,
Arch. Pharm. Med. Chem., 332, 39-41, (1999),
Am. J. Physiol., 276, H1113-1116, (1999) or
Naunyn Schmied, Arch. Pharmacol. 362, 375-381, (2000).

Objects of the present invention are the compounds of formula I per se, the use of compounds of formula I and their pharmaceutically acceptable salts for the manufacture of medicaments for the treatment of diseases, related to the adenosine A_2 receptor, their manufacture, medicaments based on a compound in accordance with the invention and their production as well as the use of compounds of formula I in the control or prevention of illnesses based on the modulation of the adenosine system, such as Alzheimer's disease, Parkinson's disease, Huntington's disease, neuroprotection,

schizophrenia, anxiety, pain, respiration deficits, depression, drug addiction, such as amphetamine, cocaine, opioids, ethanol, nicotine, cannabinoids, or against asthma, allergic responses, hypoxia, ischaemia, seizure and substance abuse. Furthermore, compounds of the present invention may be useful as sedatives, muscle relaxants, antipsychotics, antiepileptics, anticonvulsants and cardiaprotective agents for disorders such as coronary artery disease and heart failure. The most preferred indications in accordance with the present invention are those, which base on the A_{2A} receptor antagonistic activity and which include disorders of the central nervous system, for example the treatment or prevention of Alzheimer's disease, certain depressive disorders, drug addiction, neuroprotection and Parkinson's disease as well as ADHD.

As used herein, the term "lower alkyl" denotes a saturated straight- or branched-chain alkyl group containing from 1 to 6 carbon atoms, for example, methyl, ethyl, propyl, isopropyl, n-butyl, i-butyl, 2-butyl, t-butyl and the like.

The term "pharmaceutically acceptable acid addition salts" embraces salts with inorganic and organic acids, such as hydrochloric acid, nitric acid, sulfuric acid, phosphoric acid, citric acid, formic acid, fumaric acid, maleic acid, acetic acid, succinic acid, tartaric acid, methane-sulfonic acid, p-toluenesulfonic acid and the like.

Preferred compounds are those, wherein R^1 is $C_{5,6}$-cycloalkyl, substituted by CF_3, lower alkyl, $-(CH_2)_nOH$ or $-(CH_2)_n$-O-lower alkyl, for example the following compounds:

3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-trifluoromethyl-cyclohexyl)-urea,
(trans)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-methyl-cyclohexyl)-urea,
(trans)-1-(4-hydroxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea,
(trans)-1-(4-methoxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea or
(rac),(cis)-1-(3-hydroxymethyl-cyclopentyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea.

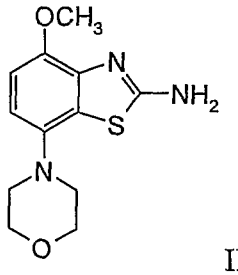
Further preferred are those compounds, wherein R^1 is
1-bicyclo[2.2.1]hept-2-yl, 1-(7-oxa-bicyclo[2.2.1]hept-2-yl, 1-(5-exo-hydroxy-

bicyclo[2.2.1]hept-2-exo-yl, 1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl or 1-adamantan-1-yl, for example the following compounds:
1-(endo)-(rac)-bicyclo[2.2.1]hept-2-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea,
(exo)-(+)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(exo)-(-)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(rac)-(endo)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(rac)-1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-exo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea,
(rac)-1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea or
1-adamantan-1-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea.

An example for compounds, wherein R^1 and R^2 form together with the N-atom the group 8-oxa-3-aza-bicyclo[3.2.1]octane is 8-oxa-3-aza-bicyclo[3.2.1]octane-3-carboxylic acid (4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-amide.

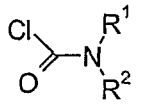
The present compounds of formula I and their pharmaceutically acceptable salts can be prepared by methods known in the art, for example, by processes described below, which process comprises

a) reacting a compound of formula



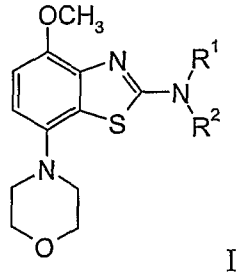
II

with a compound of formula



III

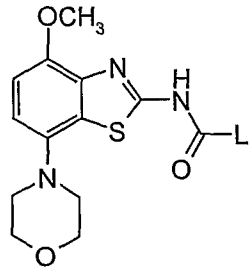
to a compound of formula



I

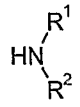
wherein R^1 and R^2 have the significances given above, or

b) reacting a compound of formula



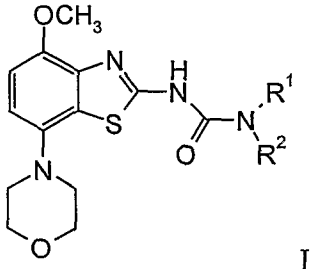
IV

with a compound of formula



V

to a compound of formula



I

wherein R^1 and R^2 are as defined above, L is a leaving group such as halogen, -O-phenyl or O-lower alkyl, and

if desired, converting the compounds obtained into pharmaceutically acceptable acid addition salts.

In Examples 1 – 13 and in the following schemes 1 and 2 the preparation of compounds of formula I is described in more detail.

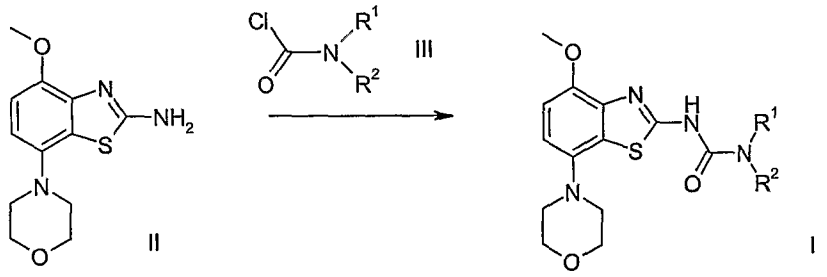
The starting materials are known compounds or may be prepared according to methods known in the art.

Preparation of compounds of formula I

The intermediate 7-(morpholin-4-yl)-4-methoxy-benzothiazol-2-ylamine (II) may be prepared according to methods disclosed in WO01/97786. The preparation of compounds of formula (I) using the intermediate of formula (II) is also described in WO01/97786.

One method of preparation of compounds of formula (I) in accordance with the following scheme 1 is as follows: To a solution of the compound of formula (II) in dichloromethane is subsequently added a base, e.g. pyridine or diisopropyl-ethylamine and a compound of formula (III), and the resulting solution is stirred for about 45 min at ambient temperature. Saturated aqueous sodium hydrogen carbonate is added, the organic phase is separated and dryed.

Scheme 1

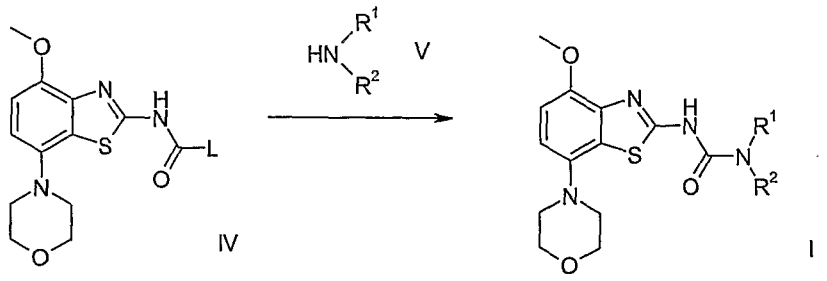


II III I

R^1 and R^2 are as described above.

Onother method of preparation of compounds of formula (I) is as follows: To a solution of the compound of a compound of formula (IV), which can be prepared according to methods well known to the art and which is described in WO01/97786, in an inert solvent, e.g. dichloromethane, is subsequently added a base, e.g. pyridine or diisopropyl-ethylamine and a compound of formula (V), and the resulting solution is stirred for about 45 min at 45 °C. After cooling to ambient temperature, saturated aqueous sodium hydrogen carbonate is added, the organic phase is separated and dryed.

Scheme 2



R^1 and R^2 are as described above, L is a leaving group such as halogen, -O-phenyl or O-lower alkyl.

Isolation and purification of the compounds

Isolation and purification of the compounds and intermediates described herein can be effected, if desired, by any suitable separation or purification procedure such as, for example, filtration, extraction, crystallization, column chromatography, thin-layer chromatography, thick-layer chromatography, preparative low or high-pressure liquid chromatography or a combination of these procedures. Specific illustrations of suitable separation and isolation procedures can be had by reference to the preparations and examples herein below. However, other equivalent separation or isolation procedures could, of course, also be used.

Salts of compounds of formula I

The compounds of formula I may be basic, for example in cases where the residue R contains a basic group such as an aliphatic or aromatic amine moiety. In such cases the compounds of formula I may be converted to a corresponding acid addition salt.

The conversion is accomplished by treatment with at least a stoichiometric amount of an appropriate acid, such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, phosphoric acid and the like, and organic acids suchas acetic acid, propionic acid, glycolic acid, pyruvic acid, oxalic acid, malic acid, malonic acid, succinic acid, maleic acid, fumaric acid, tartaric acid, citric acid, benzoic acid, cinnamic acid, mandelic acid, methanesulfonic acid, ethanesulfonic acid, p-toluenesulfonic acid, salicylic acid and the like. Typically, the free base is dissolved in an inert organic solvent such as diethyl ether, ethyl acetate, chloroform, ethanol or methanol and the like, and the acid added in a similar solvent. The temperature is maintained between 0 °C and 50 °C. The resulting salt precipitates spontaneously or may be brought out of solution with a less polar solvent.

The acid addition salts of the basic compounds of formula I may be converted to the corresponding free bases by treatment with at least a stoichiometric equivalent of a suitable base such as sodium or potassium hydroxide, potassium carbonate, sodium bicarbonate, ammonia, and the like.

The compounds of formula I and their pharmaceutically usable addition salts possess valuable pharmacological properties. Specifically, it has been found that the compounds of the present invention are adenosine receptor ligands and possess a high affinity towards the adenosine A_{2A} receptor.

The compounds were investigated in accordance with the test given hereinafter.

Human adenosine A_{2A} receptor

The human adenosine A_{2A} receptor was recombinantly expressed in chinese hamster ovary (CHO) cells using the semliki forest virus expression system. Cells were harvested, washed twice by centrifugation, homogenised and again washed by centrifugation. The final washed membrane pellet was suspended in a Tris (50 mM) buffer containing 120 mM NaCl, 5 mM KCl, 2 mM $CaCl_2$ and 10 mM $MgCl_2$ (pH 7.4) (buffer A). The [^{3}H]-SCH-58261 (Dionisotti et al., 1997, Br J Pharmacol 121, 353; 1nM) binding assay was carried out in 96-well plates in the presence of 2.5 µg of membrane protein, 0.5 mg of Ysi-poly-l-lysine SPA beads and 0.1 U adenosine deaminase in a final volume of 200 µl of buffer A. Non-specific binding was defined using xanthine amine congener (XAC; 2 µM). Compounds were tested at 10 concentrations from 10 µM - 0.3 nM. All assays were conducted in duplicate and repeated at least two times. Assay plates were incubated for 1hour at room temperature before centrifugation and then bound ligand determined using a Packard Topcount scintillation counter. IC_{50} values were calculated using a non-linear curve fitting program and Ki values calculated using the Cheng-Prussoff equation.

The pKi value of compounds of the present application are in the range of 7.3 to 8.5, as described in the table below.

Example No.	hA_2 (pKi)	Example No.	hA_2 (pKi)
1	7.7	8	8.0
2	7.8	9	7.9

3	7.8	10	8.1
4	7.7	11	8.1
5	8.4	12	7.3
6	8.1	13	8.0
7	8.5		

The compounds of formula I and the pharmaceutically acceptable salts of the compounds of formula I can be used as medicaments, e.g. in the form of pharmaceutical preparations. The pharmaceutical preparations can be administered orally, e.g. in the form of tablets, coated tablets, dragées, hard and soft gelatine capsules, solutions, emulsions or suspensions. The administration can, however, also be effected rectally, e.g. in the form of suppositories, parenterally, e.g. in the form of injection solutions.

The compounds of formula I can be processed with pharmaceutically inert, inorganic or organic carriers for the production of pharmaceutical preparations. Lactose, corn starch or derivatives thereof, talc, stearic acids or its salts and the like can be used, for example, as such carriers for tablets, coated tablets, dragées and hard gelatine capsules. Suitable carriers for soft gelatine capsules are, for example, vegetable oils, waxes, fats, semi-solid and liquid polyols and the like. Depending on the nature of the active substance no carriers are, however, usually required in the case of soft gelatine capsules. Suitable carriers for the production of solutions and syrups are, for example, water, polyols, glycerol, vegetable oil and the like. Suitable carriers for suppositories are, for example, natural or hardened oils, waxes, fats, semi-liquid or liquid polyols and the like.

The pharmaceutical preparations can, moreover, contain preservatives, solubilizers, stabilizers, wetting agents, emulsifiers, sweeteners, colorants, flavorants, salts for varying the osmotic pressure, buffers, masking agents or antioxidants. They can also contain still other therapeutically valuable substances.

Medicaments containing a compound of formula I or a pharmaceutically acceptable salt thereof and a therapeutically inert carrier are also an object of the present invention, as is a process for their production, which comprises bringing one or more compounds of formula I and/or pharmaceutically acceptable acid addition salts and, if

desired, one or more other therapeutically valuable substances into a galenical administration form together with one or more therapeutically inert carriers.

In accordance with the invention compounds of formula I as well as their pharmaceutically acceptable salts are useful in the control or prevention of illnesses based on the adenosine receptor antagonistic activity, such as Alzheimer's disease, Parkinson's disease, neuroprotection, schizophrenia, anxiety, pain, respiration deficits, depression, asthma, allergic responses, hypoxia, ischaemia, seizure and substance abuse. Furthermore, compounds of the present invention may be useful as sedatives, muscle relaxants, antipsychotics, antiepileptics, anticonvulsants and cardiaprotective agents and for the production of corresponding medicaments.

The most preferred indications in accordance with the present invention are those, which include disorders of the central nervous system, for example the treatment or prevention of certain depressive disorders, neuroprotection and Parkinson's disease.

The dosage can vary within wide limits and will, of course, have to be adjusted to the individual requirements in each particular case. In the case of oral administration the dosage for adults can vary from about 0.01 mg to about 1000 mg per day of a compound of general formula I or of the corresponding amount of a pharmaceutically acceptable salt thereof. The daily dosage may be administered as single dose or in divided doses and, in addition, the upper limit can also be exceeded when this is found to be indicated.

Tablet Formulation (Wet Granulation)

Item	Ingredients	mg/tablet			
		5 mg	25 mg	100 mg	500 mg
1.	Compound of formula I	5	25	100	500
2.	Lactose Anhydrous DTG	125	105	30	150
3.	Sta-Rx 1500	6	6	6	30
4.	Microcrystalline Cellulose	30	30	30	150
5.	Magnesium Stearate	1	1	1	1
	Total	167	167	167	831

Manufacturing Procedure

1. Mix items 1, 2, 3 and 4 and granulate with purified water.
2. Dry the granules at 50°C.
3. Pass the granules through suitable milling equipment.
4. Add item 5 and mix for three minutes; compress on a suitable press.

Capsule Formulation

Item	Ingredients	mg/capsule			
		5 mg	25 mg	100 mg	500 mg
1.	Compound of formula I	5	25	100	500
2.	Hydrous Lactose	159	123	148	---
3.	Corn Starch	25	35	40	70
4.	Talc	10	15	10	25
5.	Magnesium Stearate	1	2	2	5
	Total	200	200	300	600

Manufacturing Procedure

1. Mix items 1, 2 and 3 in a suitable mixer for 30 minutes.
2. Add items 4 and 5 and mix for 3 minutes.
3. Fill into a suitable capsule.

The following preparation and examples illustrate the invention but are not intended to limit its scope.

Example 1

3-(4-Methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-trifluoromethyl-cyclohexyl)-urea

4-Methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine is first reacted with phenyl chloroformate as described for (4-methoxy-7-phenyl-benzothiazol-2-yl)-carbamic acid benzyl ester in WO01/97786 and then with methyl-(4-trifluoromethyl-cyclohexyl)-amine. Usual workup, flash-chromatography (silica, eluent dichloromethane/methanol) and final evaporation of the solvent afforded the title compound as white crystals (96 % yield), mp 157-167 °C. MS: m/e= 473($M+H^+$).

Following the general method of example 1 the compounds of examples 2 to 12 were prepared.

Example 2

(trans)-3-(4-Methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-methyl-cyclohexyl)-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (trans)-methyl-(4-methyl-cyclohexyl)-amine, the title compound was prepared as off-white crystals (70 % yield), mp 171-173 °C. MS: m/e= 420($M+H^+$).

Example 3

(trans)-1-(4-Hydroxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (trans)-(4-hydroxymethyl-cyclohexyl)-methyl-amine, the title compound was prepared as light brown crystals (42 % yield). MS: m/e= 436($M+H^+$), mp 190 °C (dec).

Example 4

(trans)-1-(4-Methoxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (trans)-(4-methoxymethyl-cyclohexyl)-methyl-amine, the title compound was prepared as white solid (73 % yield), mp 141-143 °C. MS: m/e= 450($M+H^+$).

Example 5

(rac),(cis)-1-(3-Hydroxymethyl-cyclopentyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (rac)-(cis)-(3-methylamino-cyclopentyl)-methanol, the title compound was prepared as light yellow solid (58 % yield), mp 115-118 °C. MS: m/e= 421($M+H^+$).

Example 6

1-(endo)-(rac)-Bicyclo[2.2.1]hept-2-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (endo)-(rac)-(bicyclo[2.2.1]hept-2-yl)-methyl-amine, the title compound was prepared as white solid (65 % yield), mp 199-202 °C. MS: m/e= 417($M+H^+$).

Example 7

(exo)-(+)-3-(4-Methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (-)-(exo)-methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine, the title compound was prepared as light yellow crystals (82 % yield), mp 202-204 °C. MS: m/e= 419($M+H^+$).

Example 8

(exo)-(-)-3-(4-Methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (+)-(exo)-methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine, the title compound was prepared as light yellow crystals (82 % yield), mp 202-203 °C. MS: m/e= 419($M+H^+$).

Example 9

(rac)-(endo)-3-(4-Methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and (rac)-(endo)-methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine, the title compound was prepared as white crystals (47 % yield), mp 191-193 °C. MS: m/e= 419($M+H^+$).

Example 10

(rac)-1-(5-exo-Hydroxy-bicyclo[2.2.1]hept-2-exo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and 5-(exo)-methylamino-bicyclo[2.2.1]heptan-2-(exo)-ol, the title compound was prepared as white crystals (10 % yield), MS: m/e= 433($M+H^+$), mp 189 °C.

Example 11

(rac)-1-(5-exo-Hydroxy-bicyclo[2.2.1]hept-2-endo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and 5-(endo)-methylamino-bicyclo[2.2.1]heptan-2-(exo)-ol, the title compound was prepared as white crystals (12 % yield), MS: m/e= 433($M+H^+$), mp 189 °C.

Example 12

1-Adamantan-1-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and adamantan-1-yl-methyl-amine, the title compound was prepared as white crystals (76 % yield), mp 165-176 °C. MS: m/e= 458($M+H^+$).

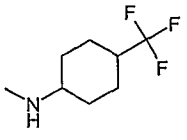
Example 13

8-Oxa-3-aza-bicyclo[3.2.1]octane-3-carboxylic acid (4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-amide

Using 4-methoxy-7-morpholin-4-yl-benzothiazol-2-ylamine, phenyl chloroformate and 8-oxa-3-aza-bicyclo[3.2.1]octane, the title compound was prepared as white crystals (67 % yield), mp 229-231 °C. MS: m/e= 405($M+H^+$).

Intermediates:

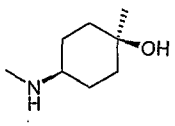
Example 14

Methyl-(4-trifluoromethyl-cyclohexyl)-amine 

The title compound was prepared from 4-trifluoromethyl-cyclohexylamine (DE 2630562) by introduction of a ethoxycarbonyl-group under standard conditions (ethyl chloroformate/diisopropyl-ethalamine), and final reduction with lithium aluminium

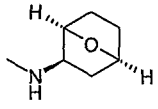
hydride in tetrahydrofurane under standard conditions to give the title compound as a light yellow oil, MS: m/e= 168($M+H^+$). The title compound can be crystallized as its hydrochloride by use of ethanolic hydrogen chloride. White crystals, mp 202-204°C.

Example 15

1-Methyl-4-(cis)-methylamino-cyclohexanol 

The title compound can be prepared from (cis)-4-amino-1-methyl-cyclohexanol (WO9607657) in exact the same manner as described for methyl-(4-trifluoromethyl-cyclohexyl)-amine. White crystals, mp 123-124°C, MS: m/e= 144($M+H^+$).

Example 15

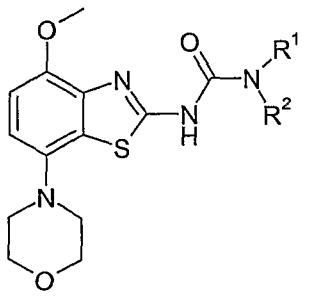
(-)-(exo)-Methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine hydrochloride 

The title compound was prepared from (rac)-(exo)-methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine (J.Med.Chem. 1971, 14, 698) by benzylation under standard conditions (benzyl bromide/diisopropyl-ethalamine), chiral resolution by preparative chiral HPLC (Chrialpak AD, eluent 2% isopropanol in heptane) and final deprotection under standard conditions (chloroethyl chloroformate/methanol) to give the title compound as white solid. $[\alpha]_D$ = -6.2(c=0.23, dichloromethane).

The anantiomer (+)-(exo)-methyl-(7-oxa-bicyclo[2.2.1]hept-2-yl)-amine hydrochloride was obtained from the earlier eluting fractions of the same resolution.

Claims

1. Compounds of the general formula



I

wherein

R^1 is $C_{5,6}$-cycloalkyl, substituted by CF_3, lower alkyl, $-(CH_2)_nOH$ or $-(CH_2)_n$-O-lower alkyl, or is
1-bicyclo[2.2.1]hept-2-yl,
1-(7-oxa-bicyclo[2.2.1]hept-2-yl,
1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-exo-yl,
1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl,
or is 1-adamantan-1-yl;

R^2 is lower alkyl; or

R^1 and R^2 form together with the N-atom the group 8-oxa-3-aza-bicyclo[3.2.1]octane;

n is 0 or 1;

and pharmaceutically acceptable acid addition salts thereof.

2. Compounds of formula I in accordance with claim 1, wherein R^1 is $C_{5,6}$-cycloalkyl substituted by CF_3, lower alkyl, $-(CH_2)_nOH$ or $-(CH_2)_n$-O-lower alkyl.

3. Compounds of formula I in accordance with claim 2, wherein the compounds are

3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-trifluoromethyl-cyclohexyl)-urea,
(trans)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(4-methyl-cyclohexyl)-urea,
(trans)-1-(4-hydroxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-

2-yl)-1-methyl-urea,
(trans)-1-(4-methoxymethyl-cyclohexyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea or
(rac),(cis)-1-(3-hydroxymethyl-cyclopentyl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea.

4. Compounds of formula I in accordance with claim 1, wherein the R^1 is 1-bicyclo[2.2.1]hept-2-yl, 1-(7-oxa-bicyclo[2.2.1]hept-2-yl, 1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-exo-yl, 1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl or 1-adamantan-1-yl.

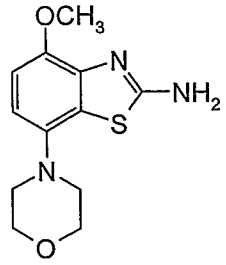
5. Compounds of formula I in accordance with claim 4, wherein the compounds are
1-(endo)-(rac)-bicyclo[2.2.1]hept-2-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea,
(exo)-(+)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(exo)-(-)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(rac)-(endo)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-1-(7-oxa-bicyclo[2.2.1]hept-2-yl)-urea,
(rac)-1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-exo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea,
(rac)-1-(5-exo-hydroxy-bicyclo[2.2.1]hept-2-endo-yl)-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea or
1-adamantan-1-yl-3-(4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-1-methyl-urea.

6. Compounds of formula I in accordance with claim 1, wherein R^1 and R^2 form together with the N-atom the group 8-oxa-3-aza-bicyclo[3.2.1]octane.

7. Compounds of formula I in accordance with claim 6, wherein the compound is 8-oxa-3-aza-bicyclo[3.2.1]octane-3-carboxylic acid (4-methoxy-7-morpholin-4-yl-benzothiazol-2-yl)-amide.

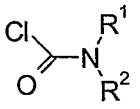
8. A process for preparing a compound of formula I as defined in claims 1 - 7, which process comprises

a) reacting a compound of formula



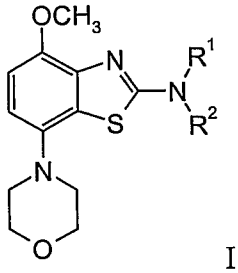
II

with a compound of formula



III

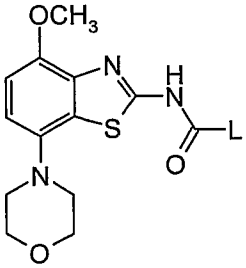
to a compound of formula



I

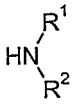
wherein R^1 and R^2 have the significances given in claim 1, or

b) reacting a compound of formula



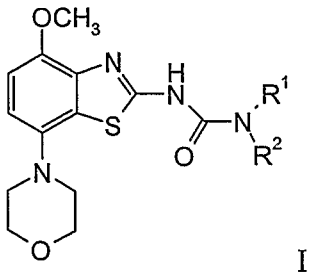
IV

with a compound of formula



V

to a compound of formula



I

wherein R^1 and R^2 are as defined in claim 1, L is a leaving group such as halogen, -O-phenyl or O-lower alkyl, and

if desired, converting the compounds obtained into pharmaceutically acceptable acid addition salts.

9. A compound according to any one of claims 1 to 7, whenever prepared by a process as claimed in claim 6 or by an equivalent method.

10. A medicament containing one or more compounds as claimed in any one of claims 1 to 7 and pharmaceutically acceptable excipients.

11. A medicament according to claim 10 for the treatment of diseases related to the adenosine receptor.

12. The use of a compound in any one of claims 1 to 7 for the treatment of diseases.

13. The use of a compound in any one of claims 1 to 7 for the manufacture of corresponding medicaments for the treatment of diseases related to the adenosine A_{2A} receptor.

14. The invention as hereinbefore described.

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