

Description

Cyclic N-[1,3,4]-thiadiazol-2-yl-benzene sulfonamides, processes for their preparation and their use as pharmaceuticals

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The invention relates to cyclic N-[1,3,4]-thiadiazol-2-yl-benzene sulfonamides and to their physiologically acceptable salts and physiologically functional derivatives showing PPARdelta or PPARdelta and PPARgamma agonist activity.

10 Benzenesulfonamino compounds which bind to PPARs are described in WO 2005/005421. Sulfonamide compounds comprising showing hypoglycemic activity are disclosed in Khimiko-Farmatsevticheskii Zhurnal (1987), 21(8), 965-8. From WO 97/40017 compounds having a phenyl group linked to heterocycles are known as modulators of molecules with phosphotyrosine recognition units.

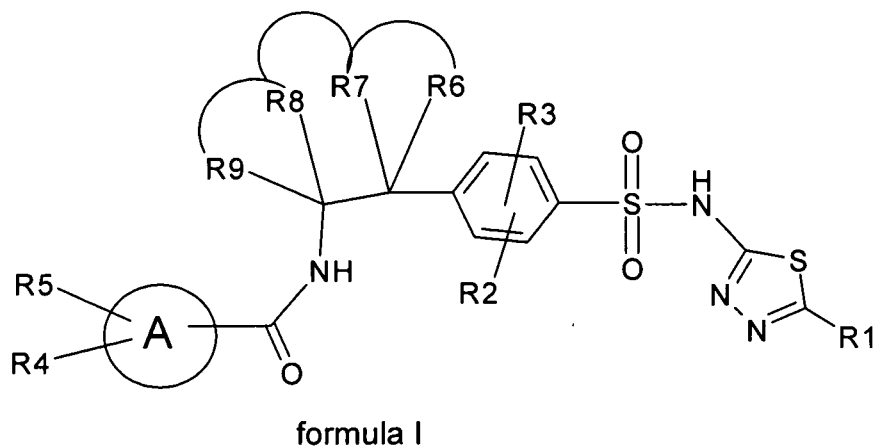
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The invention is based on the object of providing compounds which permit therapeutically utilizable modulation of lipid and/or carbohydrate metabolism and are thus suitable for the prevention and/or treatment of diseases such as type 2 diabetes and atherosclerosis and the diverse sequelae thereof. Another purpose of the

20 invention is to treat demyelinating and other neurodegenerative disorders of the central and peripheral nervous systems.

A series of compounds which modulate the activity of PPA receptors has been found. The compounds are suitable in particular for activating PPARdelta or PPARdelta and
25 PPARgamma, however it is possible that the relative activation varies depending on the specific compounds.

Compounds of the present invention are described by formula I:



5 wherein

- R1 is (C1-C6) alkyl, (C0-C6) alkylene (C3-C6) cycloalkyl, (C0-C6) alkylene-O-(C1-C6) alkyl, (C0-C6) alkylene-O-(C3-C6) cycloalkyl, (C0-C6) alkylene-(C6-C14) aryl, (C0-C6) alkylene-(C5-C15) heteroaryl, wherein alkyl, alkylene, aryl, heteroaryl and cycloalkyl can be unsubstituted or mono, di- or tri substituted by F, Cl, Br, (C1-C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃, CN, CO-(C1-C6) alkyl, COO(C1-C6) alkyl, CON((C0-C6) alkylene-H)((C0-C6) alkylene-H), S(O)_m (C1-C6) alkyl;
- 10 R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, CN, COO(C1-C6) alkyl, CON((C0-C6)alkylene-H)((C0-C6)alkylene-H), S(O)_m(C1-C6) alkyl, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;
- 15 A is (C6-C14) aryl or (C3-C12) heteroaryl;
- R4, R5 are independently H, (C1-C6) alkyl, CN, CO-(C1-C6) alkyl, COO-(C1-C6) alkyl, CON((C0-C6) alkylene-H)((C0-C6) alkylene-H), S(O)_m(C1-C6) alkyl, N((C0-C6) alkylene-H)((C0-C6) alkylene-H), N((C0-C6) alkylene-H)-CO-(C1-C6) alkyl, N((C0-C6) alkylene-H)-CO-(C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, (C0-C6) alkylene-O-(C6-C14) aryl, SCF₃, S(O)₂CF₃,
- 25

NO₂, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R₆, R₇, R₈ and R₉ are independently H, (C₁-C₆) alkyl, (C₀-C₆) alkylene-(C₃-C₆) cycloalkyl, (C₀-C₆) alkylene-(C₆-C₁₄) aryl, (C₀-C₆) alkylene-(C₅-C₁₅) heteroaryl, (C₀-C₆) alkylene-(C₃-C₁₅) heterocycloalkyl, (C₀-C₆) alkylene-(C₃-C₁₅) heterocycloalkenyl, wherein alkyl, alkylene and cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, (C₁-C₆) alkyl, (C₀-C₆) alkylene-O-(C₀-C₆)-alkylene-H, CF₃, OCF₃, CN, CO-(C₁-C₆) alkyl, COO-(C₁-C₆) alkyl, CON((C₀-C₆)alkylene-H)((C₀-C₆)alkylene-H), S(O)_m(C₁-C₆) alkyl, and wherein aryl, cycloalkyl, heterocycloalkyl, heterocycloalkenyl and heteroaryl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C₁-C₆) alkyl and (C₀-C₄) alkylene-O-(C₀-C₄) alkylene-H

and wherein at least one pair of R₆ and R₇, R₈ and R₉, or R₇ and R₈ together with the C-atomes to which they are connected form a (C₃-C₁₃) cycloalkyl, a (C₃-C₉)-heterocycloalkyl or a (C₃-C₉)-heterocycloalkenyl, wherein cycloalkyl, heterocycloalkyl and heterocycloalkenyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C₁-C₆) alkyl and (C₀-C₄) alkylene-O-(C₀-C₄) alkylene-H;

m is 0,1,2;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

Another embodiment according to the invention are compounds of the formula I, wherein

R₁ is (C₁-C₆) alkyl, (C₀-C₆) alkylene (C₃-C₆) cycloalkyl, (C₀-C₆) alkylene-O-(C₁-C₆) alkyl, (C₀-C₆) alkylene-(C₆-C₁₄) aryl, wherein alkyl, alkylene, aryl and cycloalkyl can be unsubstituted or mono, di- or tri substituted by F, Cl, Br, (C₁-

C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

A is (C6-C14) aryl or (C3-C12) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, CN, CO-(C1-C6) alkyl, COO-(C1-C6) alkyl, CON((C0-C6) alkylene-H((C0-C6) alkylene-H), halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, SCF₃, S(O)₂CF₃, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, (C0-C6) alkylene-(C3-C6) cycloalkyl, (C0-C6) alkylene-(C6-C14) aryl, wherein alkyl, alkylene and cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, (C1-C6) alkyl, (C0-C6) alkylene-O-(C0-C6)-alkylene-H, CF₃, and wherein aryl and cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl and (C0-C4) alkylene-O-(C0-C4) alkylene-H

and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together with the C-atoms to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl and (C0-C4) alkylene-O-(C0-C4) alkylene-H;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

Another embodiment according to the invention are compounds of the formula I, wherein

R1 is (C1-C6) alkyl, (C0-C6) alkylene (C3-C6) cycloalkyl, (C0-C6) alkylene-O-(C1-C6) alkyl, (C0-C6) alkylene-(C6-C14) aryl, wherein alkyl, alkylene, aryl and cycloalkyl can be unsubstituted or mono, di- or tri substituted by F, Cl, Br, (C1-C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

A is (C6-C14) aryl, (C5-C6) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, SCF₃, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, unsubstituted or mono, di- or trisubstituted by halogen,

and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together with the C-atoms to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen and (C1-C6) alkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

Another embodiment according to the invention are compounds of the formula I, wherein

R1 is (C1-C6) alkyl, unsubstituted or mono, di- or tri substituted by F;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

5 A is (C6-C10) aryl, (C5-C6) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

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R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, unsubstituted or mono, di- or trisubstituted by halogen,

and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together
15 with the C-atoms to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen and (C1-C6) alkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its
20 physiologically acceptable salts and tautomeric forms.

Another embodiment according to the invention are compounds of the formula I,
wherein

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R1 is (C1-C6) alkyl, unsubstituted or mono, di- or tri substituted by F;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H;

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A is phenyl, thiophene;

R4 is O(C1-C4)alkyl and in ortho position;

R5 is CF₃ and in para position;

5 two of R6, R7, R8 and R9 are H and at least one pair of R6 and R7 or R7 and R8 together with the C-atomes to which they are connected form a (C3-C13) cycloalkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

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Another embodiment according to the invention are compounds of the formula I, wherein

15 R1 is (C1-C6) alkyl, CF₃;

R2, R3 are H;

A is phenyl;

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R4 is O(C1-C4)alkyl and in ortho position;

R5 is CF₃ and in para position;

25 two of R6, R7, R8 and R9 are H and at least one pair of R6 and R7 or R7 and R8 together with the C-atomes to which they are connected form a (C5-C6) cycloalkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

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Another embodiment according to the invention are compounds of the formula I, wherein

A is phenyl,
R4 is ethoxy and in ortho position.

5 Another embodiment according to the invention are the compounds:

2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]
-cyclohexylmethyl}-4-trifluoromethyl-benzamide

10 2-Ethoxy-N-{trans-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)
-phenyl]-cyclopentyl}-4-trifluoromethyl-benzamide

2-Ethoxy-N-{cis-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)
-phenyl]-cyclopentyl}-4-trifluoromethyl-benzamide

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2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]
-cyclopentylmethyl}-4-trifluoromethyl-benzamide

2-Ethoxy-N-{trans-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)

20 -phenyl]-cyclopropyl}-4-trifluoromethyl-benzamide

2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]
-cyclobutylmethyl}-4-trifluoromethyl-benzamide

25 3-Ethoxy-5-trifluoromethyl-thiophene-2-carboxylic acid {1-[4-(5-isopropyl-
[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclobutylmethyl}-amide

2-Ethoxy-4-trifluoromethyl-N-{1-[4-(5-trifluoromethyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-
phenyl]-cyclopentylmethyl}-benzamide.

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This invention also encompasses all combinations of preferred aspects of the invention described herein.

As used herein, the term alkyl is to be understood in the broadest sense to mean
5 saturated hydrocarbon residues which can be linear, i. e. straight-chain, or branched. If not otherwise defined alkyl has 1 to 8 carbon atoms. Examples of “-(C1-C8)-alkyl” are alkyl residues containing 1, 2, 3, 4, 5, 6, 7 or 8 carbon atoms are methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl or octyl, the n-isomers of all these residues, isopropyl, isobutyl, 1-methylbutyl, isopentyl, neopentyl, 2,2-dimethylbutyl, 2-methylpentyl, 3-
10 methylpentyl, isohexyl, sec-butyl, tert-butyl or tert-pentyl. The term “-(C0-C8)-alkyl” is a hydrocarbon residue containing 1, 2, 3, 4, 5, 6, 7 or 8 carbon atoms, in which the term “-C0-alkyl” is a covalent bond. All these statements apply also to the term alkylene.

As used herein, the term alkenyl is to be understood in the broadest sense to mean
15 hydrocarbon residues which has 1 to 4 double bonds and can be linear, i. e. straight-chain, or branched. If not otherwise defined alkenyl has 2 to 8 carbon atoms. Examples of “-(C2-C8)-alkenyl” are alkenyl residues containing 2, 3, 4, 5, 6, 7 or 8 carbon atoms are, for example vinyl, 1-propenyl, 2-propenyl (= allyl), 2-butenyl, 3-butenyl, 2-methyl-2-butenyl, 3-methyl-2-butenyl, 5-hexenyl or 1,3-pentadienyl. All these
20 statements apply also to the term alkenylene.

As used herein, the term alkynyl is to be understood in the broadest sense to mean hydrocarbon residues, which has 1 to 4 triple bonds and can be linear, i. e. straight-chain, or branched. If not otherwise defined alkynyl has 2 to 8 carbon atoms. Examples
25 of “-(C2-C8)-alkynyl” are alkynyl residues containing 2, 3, 4, 5, 6, 7 or 8 carbon atoms are, for example ethynyl, 1-propynyl, 2-propynyl (= propargyl) or 2-butynyl. All these statements apply also to the term alkylidene.

All these statements also apply if an alkyl group occurs as a substituent on another
30 residue, for example in an alkyloxy residue, an alkyloxycarbonyl residue or an arylalkyl residue.

If not otherwise defined, alkyl, alkylene, alkenyl, alkenylene, alkynyl and alkynylene are unsubstituted or mono, di- or trisubstituted independently of one another by suitable groups such as, for example: F, Cl, Br, I, CF₃, NO₂, CN, COOH, CO-O-(C0-C4)

alkylene-(C6-C10) aryl, CO-O-(C1-C4) alkyl, CO-O-(C0-C4) alkylene-(C3-

- 5 C13)cycloalkyl, CO-O-(C0-C4) alkylene-(C3-C15)heterocycle, CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C6-C10) aryl, CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-H, CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C3-C13)cycloalkyl, CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C3-C15) heterocycle, (C0-C4) alkylene-(C3-C6)cycloalkyl, (C0-C4) alkylene-(C6-C10)aryl, (C0-C4) alkylene-(C3-C15)heterocycle,
- 10 (C2-C6)-alkenyl, (C2-C6)-alkynyl, O-(C0-C6)-alkyl, O-(C0-C4) alkylene-(C6-C10) aryl, O-(C0-C4) alkylene-(C3-C12)cycloalkyl, O-(C0-C4) alkylene-(C3-C15)heterocycle, O-CO-O-(C0-C4) alkylene-(C6-C10) aryl, O-CO-O-(C1-C4) alkyl, O-CO-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, O-CO-O-(C0-C4) alkylene-(C3-C15)heterocycle, S-(C1-C4)alkyl, S-(C0-C4) alkylene-(C3-C13)cycloalkyl, S-(C0-C4) alkylene-(C6-C10) aryl, S-
- 15 (C0-C4) alkylene-(C3-C15) heterocycle, SO-(C1-C4)alkyl, SO-(C0-C4) alkylene-(C3-C13)cycloalkyl, SO-(C0-C4) alkylene-(C6-C10) aryl, SO-(C0-C4) alkylene-(C3-C15) heterocycle, SO₂-(C1-C4)alkyl, SO₂-(C0-C4) alkylene-(C3-C13)cycloalkyl, SO₂-(C0-C4) alkylene-(C6-C10) aryl, SO₂-(C0-C4) alkylene-(C3-C15) heterocycle, SO₂-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C10)aryl, SO₂-N((C0-C4)alkylene-H)-(C0-
- 20 C4)alkylene-H, SO₂-N((C0-C4) alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, SO₂-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocyclewhere the aryl ring or heterocyclic ring is unsubstituted or mono- or disubstituted by F, Cl, Br, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H; N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, N((C0-C4) alkylene-H)-(C0-C4)alkylene-
- 25 H)-(C1-C6)cycloalkyl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-O-(C0-
- 30 C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-N((C0-C4)-

alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, where the aryl ring or heterocyclic ring is
 5 unsubstituted or mono- or disubstituted by F, Cl, Br, I, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, SO₂-CH₃, COOH, COO-(C1-C6)-alkyl, SF₅, CONH₂.

The term cycloalkyl is to be understood to mean saturated hydrocarbon cycle
 10 containing from 3 to 13 carbon atoms in a mono- or bicyclic, fused, bridged or spirocyclic ring. Examples of (C3-C13)-cycloalkyl cyclic alkyl residues are cycloalkyl residues containing 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13 ring carbon atoms like cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, cycloundecyl or cyclododecyl. The term cycloalkyl also includes bicyclic
 15 groups in which any of the above cycloalkyl ring is fused to a benzene ring, for example indane and 1,2,3,4-tetrahydronaphthalene.

The term cycloalkenyl is to be understood to mean unsaturated hydrocarbon cycle containing from 3 to 8 carbon atoms in a mono- or bicyclic, fused or bridged ring,
 20 wherein the one, two or three double bonds are not located within a cyclic alkyl group in such a manner that an aromatic system results. Examples of unsaturated cycloalkenyl groups are cyclopentenyl or cyclohexenyl, which can be bonded via any carbon atom. The term cycloalkenyl also includes bicyclic groups in which any of the above cycloalkenyl ring is fused to a benzene ring, for example 1,2-
 25 dihydronaphthalene, 1,4-dihydronaphthalene and 1H-indene.

If not otherwise defined cycloalkyl or cycloalkenyl are unsubstituted or mono, di- or trisubstituted independently of one another by suitable groups such as, for example: F, Cl, Br, I, CF₃, NO₂, CN, COOH, CO-O-(C0-C4) alkylene-(C6-C10) aryl, CO-O-(C1-C4)
 30 alkyl, CO-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, CO-O-(C0-C4) alkylene-(C3-C15)heterocycle,, CO-N((C0-C4) alkylene-H)-(C1-C6)alkylene-H, CO-N((C0-C4) alkylene-H)-(C1-C6)cycloalkyl, CON((C0-C4) alkylene-H)-(C0-C4)alkylene-(C6-C12)-

aryl, (C0-C4) alkylene-(C3-C6)cycloalkyl, (C3-C6)alkyl, (C2-C6)-alkenyl, (C2-C6)-alkinyl, (C0-C4) alkylene-(C6-C10)aryl, (C0-C4) alkylene-(C3-C15)heterocycle, O-(C0-C6)-alkyl, (C0-C4) alkylene-O-(C0-C4) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C6-C10)aryl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C3-C15)heterocycle, O-CO-O-(C0-C4) alkylene-(C6-C10) aryl, O-CO-O-(C1-C4) alkyl, O-CO-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, O-CO-O-(C0-C4) alkylene-(C3-C15)heterocycle, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-(C6-C10) aryl, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-H, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-(C3-C13)cycloalkyl, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-(C3-C15) heterocycle, S-(C1-C4)alkyl, S-(C0-C4) alkylene-(C3-C13)cycloalkyl, S-(C0-C4) alkylene-(C6-C10) aryl, S-(C0-C4) alkylene-(C3-C15) heterocycle, SO-(C1-C4)alkyl, SO-(C0-C4) alkylene-(C3-C13)cycloalkyl, SO-(C0-C4) alkylene-(C6-C10) aryl, SO-(C0-C4) alkylene-(C3-C15) heterocycle, SO2-(C1-C4)alkyl, SO2-(C0-C4) alkylene-(C3-C13)cycloalkyl, SO2-(C0-C4) alkylene-(C6-C10) aryl, SO2-(C0-C4) alkylene-(C3-C15) heterocycle, SO2-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C10)aryl, SO2-N((C0-C4)alkylene-H)-(C0-C4)alkylene-H, SO2-N((C0-C4) alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, SO2-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, where the aryl ring or heterocyclic ring is unsubstituted or mono- or disubstituted by F, Cl, Br, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H; N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, N((C0-C4) alkylene-H)-(C0-C4)alkylene-H-(C1-C6)cycloalkyl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-O-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-

(C0-C4)alkylene-(C3-C15)heterocycle, where the aryl or heterocyclic ring is unsubstituted or mono- or disubstituted by F, Cl, Br, I, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, SO₂-CH₃, COOH, COO-(C1-C6)-alkyl, SF₅, CONH₂.

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The term "aryl" is understood to mean aromatic hydrocarbon ring containing from 6 to 14 carbon atoms in a mono- or bicyclic ring. Examples of (C6-C14)-aryl rings are phenyl, naphthyl, for example 1-naphthyl and 2-naphthyl, biphenyl, for example 2-biphenyl, 3-biphenyl and 4-biphenyl, anthryl or fluorenyl. Biphenyl rings, naphthyl ring and, in particular, phenyl ring are further embodiments of aryl ring.

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The term heterocycle is understood to mean saturated (heterocycloalkyl), partly unsaturated (heterocycloalkenyl) or unsaturated (heteroaryl) hydrocarbon rings containing from 3 to 15 carbon atoms in a mono- or bicyclic, fused, bridged or spirocyclic ring in which 1 to 5 carbon atoms of the 3 to 15 ring carbon atoms are replaced by heteroatoms such as nitrogen, oxygen or sulfur in which further the heteroatoms can be oxidized, for example N=O, S=O, SO₂. Examples of heterocycles are acridinyl, azaindole (1H-pyrrolopyridinyl), azabenzimidazolyl, azaspirodecanyl, azepinyl, azetidyl, aziridinyl, benzimidazolyl, benzofuranyl, dihydrobenzofuranyl, benzothiofuranyl, benzothiophenyl, benzoxazolyl, benzthiazolyl, benztriazolyl, benztetrazolyl, benzisoxazolyl, benzisothiazolyl, carbazolyl, 4aH-carbazolyl, carbolinyl, chromanyl, chromenyl, cinnolinyl, decahydrochinolinyl, 4,5-dihydrooxazolyl, dioxazolyl, dioxazinyl, 1,3-dioxolanyl, 1,3-dioxolenyl, 3,3-dioxo[1,3,4]oxathiazinyl, 6H-1,5,2-dithiazinyl, dihydrofuro[2,3-b]-tetrahydrofuranyl, furanyl, furazanyl, imidazolidinyl, imidazolyl, 1H-indazolyl, indolinyl, indolizyl, indolyl, 3H-indolyl, isobenzofuranyl, isochromanyl, isoindazolyl, isoindolinyl, isoindolyl, isoquinolinyl (benzimidazolyl), isothiazolyl, isothiazolidinyl, isothiazolinyl, isoxazolyl, isoxazolyl, isoxazolidinyl, 2-isoxazolyl, ketopiperazinyl, morpholinyl, naphthyridinyl, octahydroisoquinolinyl, oxadiazolyl, 1,2,3-oxadiazolyl, 1,2,4-oxadiazolyl, 1,2,5-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2-oxa-thiepanyl, 1,2-oxathiolanyl, 1,4-oxazepanyl, 1,4-oxazepinyl, 1,2-oxazinyl, 1,3-oxazinyl, 1,4-oxazinyl, oxazolidinyl, oxazolyl, oxazolyl, oxetanyl, oxocanyl, phenanthridinyl, phenanthrolinyl, phenazinyl, phenothiazinyl,

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phenoxathiinyl, phenoxazinyl, phthalazinyl, piperazinyl, piperidinyl, pteridinyl, purinyl, pyranyl, pyrazinyl, pyrazolidinyl, pyrazolinyl, pyrazolyl, pyridazinyl, pyridooxazolyl, pyridoimidazolyl, pyridothiazolyl, pyridinyl, pyridyl, pyrimidinyl, pyrrolidinyl, pyrrolidinonyl, pyrrolinyl, 2H-pyrrolyl, pyrrolyl, quinazolinyl, quinolinyl, 4H-quinoliziny, quinoxaliny, quinuclidinyl, tetrahydrofuranyl, tetrahydroisoquinolinyl, tetrahydroquinolinyl, tetrahydrofuranyl, tetrahydropyranyl, tetrahydropyridinyl, tetrahydrothiophenyl, tetrazinyl, tetrazolyl, 6H-1,2,5-thiadiazinyl, 1,2,3-thiadiazolyl, 1,2,4-thiadiazolyl, 1,2,5-thiadiazolyl, 1,3,4-thiadiazolyl, thianthrenyl, 1,2-thiazinyl, 1,3-thiazinyl, 1,4-thiazinyl, 1,3-thiazolyl, thiazolyl, thiazolidinyl, thiazolinyl, thienyl, thietanyl, thienothiazolyl, thienooxazolyl, thienoimidazolyl, thiomorpholinyl, thiophenolyl, thiophenyl, thiopyranyl, 1,2,3-triazinyl, 1,2,4-triazinyl, 1,3,5-triazinyl, 1,2,3-triazolyl, 1,2,3-triazolyl, 1,2,4-triazolyl, 1,2,5-triazolyl, 1,3,4-triazolyl and xanthenyl.

The heterocyclic rings are unsubstituted or mono-, di- or trisubstituted by suitable groups such as, for example: F, Cl, Br, I, CF₃, NO₂, CN, COOH, CO-O-(C0-C4) alkylene-(C6-C10) aryl, CO-O-(C1-C4) alkyl, CO-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, CO-O-(C0-C4) alkylene-(C3-C15)heterocycle,, CO-N((C0-C4) alkylene-H)-(C1-C6)alkylene-H, CO-N((C0-C4) alkylene-H)-(C1-C6)cycloalkyl, CON((C0-C4) alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, (C0-C4) alkylene-(C3-C6)cycloalkyl, (C3-C6)alkyl, (C2-C6)-alkenyl, (C2-C6)-alkinyl, (C0-C4) alkylene-(C6-C10)aryl, (C0-C4) alkylene-(C3-C15)heterocycle, O-(C0-C6)-alkyl, (C0-C4) alkylene-O-(C0-C4) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C6-C10)aryl, (C0-C4) alkylene-O-(C0-C4) alkylene-(C3-C15)heterocycle, O-CO-O-(C0-C4) alkylene-(C6-C10) aryl, O-CO-O-(C1-C4) alkyl, O-CO-O-(C0-C4) alkylene-(C3-C13)cycloalkyl, O-CO-O-(C0-C4) alkylene-(C3-C15)heterocycle, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C6-C10) aryl, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene-H, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C3-C13)cycloalkyl, O-CO-N((C0-C4) alkylene-H)-(C0-C4) alkylene- (C3-C15) heterocycle, S-(C1-C4)alkyl, S-(C0-C4) alkylene-(C3-C13)cycloalkyl, S-(C0-C4) alkylene-(C6-C10) aryl, S-(C0-C4) alkylene-(C3-C15) heterocycle, SO-(C1-C4)alkyl, SO-(C0-C4) alkylene-(C3-C13)cycloalkyl, SO-(C0-C4) alkylene-(C6-C10) aryl, SO-(C0-C4) alkylene-(C3-C15) heterocycle, SO₂-(C1-C4)alkyl, SO₂-(C0-C4) alkylene-(C3-

C13)cycloalkyl, SO₂-(C0-C4) alkylene-(C6-C10) aryl, SO₂-(C0-C4) alkylene-(C3-C15) heterocycle, SO₂-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C10)aryl, SO₂-N((C0-C4)alkylene-H)-(C0-C4)alkylene-H, SO₂-N((C0-C4) alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, SO₂-N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle,

5 where the aryl ring or heterocyclic ring is unsubstituted or mono- or disubstituted by F, Cl, Br, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H,;

N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, N((C0-C4) alkylene-H)-(C0-C4)alkylene-H)-(C1-C6)cycloalkyl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-O-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-O-(C0-C4)alkylene-(C3-C15)heterocycle, N((C0-C4) alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C6-C12)-aryl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C3-C13)cycloalkyl, N((C0-C4)alkylene-H)-CO-N((C0-C4)-alkylene-H)-(C0-C4)alkylene-(C3-C15)heterocycle, where the aryl or heterocyclic ring is unsubstituted or mono- or disubstituted by F, Cl, Br, I, OH, CF₃, NO₂, CN, OCF₃, O-(C1-C6)-alkyl, (C1-C6)-alkyl, N((C0-C4)-alkylene-H)-(C0-C4)-alkylene-H, SO₂-CH₃, COOH, COO-(C1-C6)-alkyl, SF₅, CONH₂.

25 The term "oxo-residue" or "=O" refers to residues such as carbonyl (-CO-), nitroso (-N=O), sulfinyl (-SO- or sulfonyl (-SO₂-).

Halogen is fluorine, chlorine, bromine or iodine.

30 Optically active carbon atoms present in the compounds of the formula I can independently of each other have R configuration or S configuration. The compounds of the formula I can be present in the form of pure enantiomers or pure diastereomers

or in the form of mixtures of enantiomers and/or diastereomers, for example in the form of racemates. The present invention relates to pure enantiomers and mixtures of enantiomers as well as to pure diastereomers and mixtures of diastereomers. The invention comprises mixtures of two or of more than two stereoisomers of the formula I and it comprises all ratios of the stereoisomers in the mixtures. In case the compounds of the formula I can be present as E isomers or Z isomers (or cis isomers or trans isomers) the invention relates both to pure E isomers and pure Z isomers and to E/Z mixtures in all ratios. The invention also comprises all tautomeric forms of the compounds of the formula I.

Diastereomers, including E/Z isomers, can be separated into the individual isomers, for example, by chromatography. Racemates can be separated into the two enantiomers by customary methods, for example by chromatography on chiral phases or by resolution, for example by crystallization of diastereomeric salts obtained with optically active acids or bases. Stereochemically uniform compounds of the formula I can also be obtained by employing stereochemically uniform starting materials or by using stereoselective reactions.

The compounds of the formula I may exist in the form of their racemates, racemic mixtures, pure enantiomers, diastereomers and mixtures of diastereomers as well in their tautomeric forms. The present invention encompasses all these isomeric and tautomeric forms of the compounds of the formula I. These isomeric forms can be obtained by known methods even if not specifically described in some cases.

Pharmaceutically acceptable salts are, because their solubility in water is greater than that of the initial or basic compounds, particularly suitable for medical applications. These salts must have a pharmaceutically acceptable anion or cation. Suitable pharmaceutically acceptable acid addition salts of the compounds of the invention are salts of inorganic acids such as hydrochloric acid, hydrobromic, phosphoric, metaphosphoric, nitric and sulfuric acid, and of organic acids such as, for example, acetic acid, benzenesulfonic, benzoic, citric, ethanesulfonic, fumaric, gluconic, glycolic, isethionic, lactic, lactobionic, maleic, malic, methanesulfonic, succinic,

p-toluenesulfonic and tartaric acid. Suitable pharmaceutically acceptable basic salts are ammonium salts, alkali metal salts (such as sodium and potassium salts), alkaline earth metal salts (such as magnesium and calcium salts), and salts of trometamol (2-amino-2-hydroxymethyl-1,3-propanediol), diethanolamine, lysine or
5 ethylenediamine.

Salts with a pharmaceutically unacceptable anion such as, for example, trifluoroacetate likewise belong within the framework of the invention as useful intermediates for the preparation or purification of pharmaceutically acceptable salts
10 and/or for use in nontherapeutic, for example in vitro, applications.

The term "physiologically functional derivative" used herein refers to any physiologically tolerated derivative of a compound of the formula I of the invention, for example an ester, which on administration to a mammal such as, for example, a
15 human is able to form (directly or indirectly) a compound of the formula I or an active metabolite thereof.

Physiologically functional derivatives also include prodrugs of the compounds of the invention, as described, for example, in H. Okada et al., Chem. Pharm. Bull. 1994, 42,
20 57-61. Such prodrugs can be metabolized in vivo to a compound of the invention. These prodrugs may themselves be active or not.

The compounds of the invention may also exist in various polymorphous forms, for example as amorphous and crystalline polymorphous forms. All polymorphous forms
25 of the compounds of the invention belong within the framework of the invention and are a further aspect of the invention.

All references to "compound(s) of formula I" hereinafter refer to compound(s) of the formula I as described above, and their salts, solvates and physiologically functional
30 derivatives as described herein.

Use

This invention relates further to the use of compounds of the formula I and their pharmaceutical compositions as PPAR ligands. The PPAR ligands of the invention are suitable as modulators of PPAR activity.

- 5 Peroxisome proliferator-activated receptors (PPAR) are transcription factors which can be activated by ligands and belong to the class of nuclear hormone receptors. There are three PPAR isoforms, PPARalpha, PPARgamma and PPARdelta (identical to PPARbeta), which are encoded by different genes (Peroxisome proliferator-activated receptor (PPAR): structure, mechanisms of activation and diverse functions: Motojima
10 K., Cell Struct Funct., 1993, 18(5), 267-77).

In humans, PPARgamma exists in three variants, PPARgamma₁, gamma₂, and gamma₃, which are the result of alternative use of promoters and differential mRNA splicing. Different PPARs have different tissue distribution and modulate different
15 physiological functions. The PPARs play a key role in various aspects of the regulation of a large number of genes, the products of which genes are directly or indirectly crucially involved in lipid and carbohydrate metabolism. Thus, for example, the PPARalpha receptor plays an important part in the regulation of fatty acid catabolism or lipoprotein metabolism in the liver, while PPARgamma is crucially involved for
20 example in regulating adipose cell differentiation. In addition, however, PPARs are also involved in the regulation of many other physiological processes, including those which are not directly connected with carbohydrate or lipid metabolism. The activity of different PPARs can be modulated by various fatty acids, fatty acid derivatives and synthetic compounds to varying extents. For relevant reviews about functions,
25 physiological effects and pathophysiology, see: Berger, J. et al., Annu. Rev. Med., 2002, 53, 409-435; Wilson, T. et al., J. Med. Chem., 2000, 43 (4), 527-550; Kliewer, S. et al., Recent Prog Horm Res., 2001, 56, 239-63; Moller, D.E. and Berger, J.P., Int J Obes Relat Metab Disord., 2003, 27 Suppl 3, 17-21; Ram, V.J., Drugs Today, 2003, 39(8), 609-32).

30 Among the three PPAR-isoforms the physiological functions of PPARdelta have long remained an enigma. The first proposed pharmacological role for PPARdelta has been

the regulation of cholesterol homeostasis. It was shown that the somewhat selective PPARdelta ligand L-165041 raises plasma cholesterol in a diabetic animal model (Berger J. et al., J. Biol. Chem., 1999, 274, 6718-6725; Leibowitz M.D. et al., FEBS Lett., 2000, 473(3), 333-336). In obese, insulin resistant rhesus monkeys, the potent and selective PPARdelta ligand GW501516 raises HDL-cholesterol, decreases plasma LDL-cholesterol, triglycerides and insulin levels (Oliver, W. et al., Proc. Natl. Acad. Sci., 2001, 98, 5306-5311). The dual PPARdelta/PPARalpha agonist YM-16638 significantly lowers plasma lipids in rhesus and cynomolgus monkeys (Goto, S. et al., Br. J. Pharm., 1996, 118, 174-178) and acts in a similar manner in two weeks clinical trials in healthy volunteers (Shimokawa, T. et al., Drug Dev. Res., 1996, 38, 86-92). More recent publications underline that PPARdelta is an important target for the treatment of dyslipidemia, insulin resistance, type 2 diabetes, atherosclerosis and syndrom X (Wang, Y-X. et al., Cell, 2003, 113, 159-170; Luquet, S. et al., FASEB J., 2003, 17, 209-226 ; Tanaka, T. et al., PNAS, 2003, 100, 15924-15929 ; Holst, D. et al., BioChem. Biophys. Acta, 2003, 1633, 43-50; Dressel, U. et al., Mol. Endocrin., 2003, 17, 2477-2493 ; Lee, C.H. et al., Science, 2003, 302, 453-457).

Besides its actions as a regulator of the lipid-, glucose- and cholesterol-metabolism PPARdelta is known to play a role in embryonic development, implantation and bone formation (Lim, H. and Dey, S.K., Trends Endocrinol Metab., 2000, 11(4), 137-42; Ding, N.Z. et al., Mol Reprod Dev., 2003, 66(3), 218-24; Mano, H. et al., J Biol Chem., 2000, 275(11), 8126-32).

Numerous publications demonstrate that PPARdelta is triggering proliferation and differentiation of keratinocytes which points to its role in skin disorders and wound healing (Di-Poi, N. et al., J Steroid Biochem Mol Biol., 2003, 85(2-5), 257-65; Tan, N.S. et al., Am J Clin Dermatol., 2003, 4(8), 523-30; Wahli, W., Swiss Med Wkly., 2002, 132(7-8), 83-91).

PPARdelta appears to be significantly expressed in the CNS; however much of its function there still remains undiscovered. Of singular interest however, is the discovery that PPARdelta was expressed in rodent oligodendrocytes, the major lipid producing cells of the CNS (J. Granneman, et al., J. Neurosci. Res., 1998, 51, 563-573). Moreover, it was also found that a PPARdelta selective agonist was found to

significantly increase oligodendroglial myelin gene expression and myelin sheath diameter in mouse cultures (I. Saluja et al., *Glia*, 2001, 33, 194-204). Thus, PPARdelta activators may be of use for the treatment of demyelinating and dysmyelinating diseases. The use of peroxisome proliferator activated receptor delta agonists for the treatment of MS and other demyelinating diseases can be shown as described in WO2005/097098.

Demyelinating conditions are manifested in loss of myelin - the multiple dense layers of lipids and protein which cover many nerve fibers. These layers are provided by oligodendroglia in the central nervous system (CNS), and Schwann cells in the peripheral nervous system (PNS). In patients with demyelinating conditions, demyelination may be irreversible; it is usually accompanied or followed by axonal degeneration, and often by cellular degeneration. Demyelination can occur as a result of neuronal damage or damage to the myelin itself - whether due to aberrant immune responses, local injury, ischemia, metabolic disorders, toxic agents, or viral infections (Prineas and McDonald, *Demyelinating Diseases*. In *Greenfield's Neuropathology*, 6.sup.th ed. (Edward Arnold: New York, 1997) 813-811, Beers and Berkow, eds., *The Merck Manual of Diagnosis and Therapy*, 17.sup.th ed. (Whitehouse Station, N.J.: Merck Research Laboratories, 1999) 1299, 1437, 1473-76, 1483).

Central demyelination (demyelination of the CNS) occurs in several conditions, often of uncertain etiology, that have come to be known as the primary demyelinating diseases. Of these, multiple sclerosis (MS) is the most prevalent. Other primary demyelinating diseases include adrenoleukodystrophy (ALD), adrenomyeloneuropathy, AIDS-vacuolar myelopathy, HTLV-associated myelopathy, Leber's hereditary optic atrophy, progressive multifocal leukoencephalopathy (PML), subacute sclerosing panencephalitis, Guillian-Barre syndrome and tropical spastic paraparesis. In addition, there are acute conditions in which demyelination can occur in the CNS, e.g., acute disseminated encephalomyelitis (ADEM) and acute viral encephalitis. Furthermore, acute transverse myelitis, a syndrome in which an acute spinal cord transection of unknown cause affects both gray and white matter in one or more adjacent thoracic segments, can also result in demyelination. Also, disorders in which myelin forming glial cells are damaged including spinal cord injuries, neuropathies and nerve injury.

The present invention relates to compounds of the formula I suitable for modulating the activity of PPARs, especially the activity of PPARdelta and PPARalpha. Depending on the modulation profile, the compounds of the formula I are suitable for the treatment, control and prophylaxis of the indications described hereinafter, and for a number of other pharmaceutical applications connected thereto (see, for example, Berger, J., et al., Annu. Rev. Med., 2002, 53, 409-435; Wilson, T. et al., J. Med. Chem., 2000, 43(4), 527-550; Kliewer, S. et al., Recent Prog Horm Res., 2001, 56, 239-63; Fruchart, J.C. et al., 2001, Pharmacological Research, 44(5), 345-52; Kersten, S. et al., Nature, 2000, 405, 421-424; Torra, I.P. et al., Curr Opin Lipidol, 2001, 12, 245-254).

Compounds of this type are particularly suitable for the treatment and/or prevention of:

1. - Disorders of fatty acid metabolism and glucose utilization disorders.
 - Disorders in which insulin resistance is involved
2. Diabetes mellitus, especially type 2 diabetes, including the prevention of the sequelae associated therewith.

Particular aspects in this connection are

 - hyperglycemia,
 - improvement in insulin resistance,
 - improvement in glucose tolerance,
 - protection of the pancreatic β cells
 - prevention of macro- and microvascular disorders
3. Dyslipidemias and their sequelae such as, for example, atherosclerosis, coronary heart disease, cerebrovascular disorders etc, especially those (but not restricted thereto) which are characterized by one or more of the following factors:
 - high plasma triglyceride concentrations, high postprandial plasma triglyceride concentrations,
 - low HDL cholesterol concentrations
 - low ApoA lipoprotein concentrations
 - high LDL cholesterol concentrations
 - small dense LDL cholesterol particles

- high ApoB lipoprotein concentrations

4. Various other conditions which may be associated with the metabolic syndrome, such as:

- 5 - obesity (excess weight), including central obesity
- thromboses, hypercoagulable and prothrombotic states (arterial and venous)
- high blood pressure
- heart failure such as, for example (but not restricted thereto), following myocardial infarction, hypertensive heart disease or cardiomyopathy

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5. Disorders or conditions in which inflammatory reactions are involved:

- atherosclerosis such as, for example (but not restricted thereto), coronary sclerosis including angina pectoris or myocardial infarction, stroke
- vascular restenosis or reocclusion
- 15 - chronic inflammatory bowel diseases such as, for example, Crohn's disease and ulcerative colitis
- asthma
- lupus erythematosus (LE) or inflammatory rheumatic disorders such as, for example, rheumatoid arthritis
- 20 - other inflammatory states

6. Disorders of cell cycle or cell differentiation processes:

- adipose cell tumors
- lipomatous carcinomas such as, for example, liposarcomas
- 25 - solid tumors and neoplasms such as, for example (but not restricted thereto), carcinomas of the gastrointestinal tract, of the liver, of the biliary tract and of the pancreas, endocrine tumors, carcinomas of the lungs, of the kidneys and the urinary tract, of the genital tract, prostate carcinomas etc
- acute and chronic myeloproliferative disorders and lymphomas
- 30 - angiogenesis

7. Demyelinating and other neurodegenerative disorders of the central and peripheral nervous systems including:

- Alzheimer's disease
 - multiple sclerosis
 - 5 - Parkinson's disease
 - adrenoleukodystrophy (ALD)
 - adrenomyeloneuropathy
 - AIDS-vacuolar myelopathy
 - HTLV-associated myelopathy
 - 10 - Leber's hereditary optic atrophy
 - progressive multifocal leukoencephalopathy (PML)
 - subacute sclerosing panencephalitis
 - Guillian-Barre syndrome
 - tropical spastic paraparesis
 - 15 - acute disseminated encephalomyelitis (ADEM)
 - acute viral encephalitis
 - acute transverse myelitis
 - spinal cord and brain trauma
 - Charcot-Marie-Tooth disease
 - 20
8. Skin disorders and/or disorders of wound healing processes:
- erythemato-squamous dermatoses such as, for example, psoriasis
 - acne vulgaris
 - other skin disorders and dermatological conditions which are modulated by
 - 25 PPAR
 - eczemas and neurodermitis
 - dermatitis such as, for example, seborrheic dermatitis or photodermatitis
 - keratitis and keratoses such as, for example, seborrheic keratoses, senile keratoses, actinic keratosis, photo-induced keratoses or keratosis follicularis
 - 30 - keloids and keloid prophylaxis
 - warts, including condylomata or condylomata acuminata
 - human papilloma viral (HPV) infections such as, for example, venereal

papillomata, viral warts such as, for example, molluscum contagiosum, leukoplakia

- papular dermatoses such as, for example, Lichen planus
- skin cancer such as, for example, basal-cell carcinomas, melanomas or cutaneous T-cell lymphomas
- localized benign epidermal tumors such as, for example, keratoderma, epidermal naevi
- chilblains
- wound healing

9. Other disorders

- high blood pressure
- pancreatitis
- syndrome X
- polycystic ovary syndrome (PCOS)
- asthma
- osteoarthritis
- lupus erythematosus (LE) or inflammatory rheumatic disorders such as, for example, rheumatoid arthritis
- vasculitis
- wasting (cachexia)
- gout
- ischemia/reperfusion syndrome
- acute respiratory distress syndrome (ARDS)

Formulations

The amount of a compound of formula I necessary to achieve the desired biological effect depends on a number of factors, for example the specific compound chosen, the intended use, the mode of administration and the clinical condition of the patient. The daily dose is generally in the range from 0.001 mg to 100 mg (typically from 0.01 mg to

50 mg) per day and per kilogram of bodyweight, for example 0.1-10 mg/kg/day. An intravenous dose may be, for example, in the range from 0.001 mg to 1.0 mg/kg, which can suitably be administered as infusion of 10 ng to 100 ng per kilogram and per minute. Suitable infusion solutions for these purposes may contain, for example, from 5 0.1 ng to 10 mg, typically from 1 ng to 10 mg, per milliliter. Single doses may contain, for example, from 1 mg to 10 g of the active ingredient. Thus, ampules for injections may contain, for example, from 1 mg to 100 mg, and single-dose formulations which can be administered orally, such as, for example, capsules or tablets, may contain, for example, from 0.05 to 1000 mg, typically from 0.5 to 600 mg. For the therapy of the 10 abovementioned conditions, the compounds of formula I may be used as the compound itself, but they are preferably in the form of a pharmaceutical composition with an acceptable carrier. The carrier must, of course, be acceptable in the sense that it is compatible with the other ingredients of the composition and is not harmful for the patient's health. The carrier may be a solid or a liquid or both and is preferably 15 formulated with the compound as a single dose, for example as a tablet, which may contain from 0.05% to 95% by weight of the active ingredient. Other pharmaceutically active substances may likewise be present, including other compounds of formula I. The pharmaceutical compositions of the invention can be produced by one of the known pharmaceutical methods, which essentially consist of mixing the ingredients 20 with pharmacologically acceptable carriers and/or excipients.

Pharmaceutical compositions of the invention are those suitable for oral, rectal, topical, peroral (for example sublingual) and parenteral (for example subcutaneous, intramuscular, intradermal or intravenous) administration, although the most suitable 25 mode of administration depends in each individual case on the nature and severity of the condition to be treated and on the nature of the compound of formula I used in each case. Coated formulations and coated slow-release formulations also belong within the framework of the invention. Preference is given to acid- and gastric juice-resistant formulations. Suitable coatings resistant to gastric juice comprise cellulose 30 acetate phthalate, polyvinyl acetate phthalate, hydroxypropylmethylcellulose phthalate and anionic polymers of methacrylic acid and methyl methacrylate.

Suitable pharmaceutical preparations for oral administration may be in the form of separate units such as, for example, capsules, cachets, suckable tablets or tablets, each of which contain a defined amount of the compound of formula I; as powders or granules, as solution or suspension in an aqueous or nonaqueous liquid; or as an oil-in-water or water-in-oil emulsion. These compositions may, as already mentioned, be prepared by any suitable pharmaceutical method which includes a step in which the active ingredient and the carrier (which may consist of one or more additional ingredients) are brought into contact. The compositions are generally produced by uniform and homogeneous mixing of the active ingredient with a liquid and/or finely divided solid carrier, after which the product is shaped if necessary. Thus, for example, a tablet can be produced by compressing or molding a powder or granules of the compound, where appropriate with one or more additional ingredients. Compressed tablets can be produced by tableting the compound in free-flowing form such as, for example, a powder or granules, where appropriate mixed with a binder, glidant, inert diluent and/or one (or more) surface-active/dispersing agent(s) in a suitable machine. Molded tablets can be produced by molding the compound, which is in powder form and is moistened with an inert liquid diluent, in a suitable machine.

Pharmaceutical compositions which are suitable for peroral (sublingual) administration comprise suckable tablets which contain a compound of formula I with a flavoring, normally sucrose and gum arabic or tragacanth, and pastilles which comprise the compound in an inert base such as gelatin and glycerol or sucrose and gum arabic.

Pharmaceutical compositions suitable for parenteral administration comprise preferably sterile aqueous preparations of a compound of formula I, which are preferably isotonic with the blood of the intended recipient. These preparations are preferably administered intravenously, although administration may also take place by subcutaneous, intramuscular or intradermal injection. These preparations can preferably be produced by mixing the compound with water and making the resulting solution sterile and isotonic with blood. Injectable compositions of the invention generally contain from 0.1 to 5% by weight of the active compound.

Pharmaceutical compositions suitable for rectal administration are preferably in the form of single-dose suppositories. These can be produced by mixing a compound of the formula I with one or more conventional solid carriers, for example cocoa butter, and shaping the resulting mixture.

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Pharmaceutical compositions suitable for topical use on the skin are preferably in the form of ointment, cream, lotion, paste, spray, aerosol or oil. Carriers which can be used are petrolatum, lanolin, polyethylene glycols, alcohols and combinations of two or more of these substances. The active ingredient is generally present in a concentration of

10 from 0.1 to 15% by weight of the composition, for example from 0.5 to 2%.

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Transdermal administration is also possible. Pharmaceutical compositions suitable for transdermal uses can be in the form of single plasters which are suitable for long-term close contact with the patient's epidermis. Such plasters suitably contain the active ingredient in an aqueous solution which is buffered where appropriate, dissolved and/or dispersed in an adhesive or dispersed in a polymer. A suitable active ingredient concentration is about 1% to 35%, preferably about 3% to 15%. A particular possibility is for the active ingredient to be released by electrotransport or iontophoresis as described, for example, in *Pharmaceutical Research*, 2(6): 318 (1986).

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The compounds of the formula I are distinguished by favorable effects on metabolic disorders. They beneficially influence lipid and sugar metabolism, in particular they lower the triglyceride level and are suitable for the prevention and treatment of type II diabetes and atherosclerosis and the diverse sequelae thereof.

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Combinations with other medicaments

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The compounds of the invention can be administered alone or in combination with one or more further pharmacologically active substances. In particular, the compounds of the invention can be administered in combination with active ingredients having a similar pharmacological action. For example, they can be administered in combination with active ingredients which have favorable effects on metabolic disturbances or

disorders frequently associated therewith. Examples of such medicaments are

1. medicaments which lower blood glucose, antidiabetics,
2. active ingredients for the treatment of dyslipidemias,
- 5 3. antiatherosclerotic medicaments,
4. antiobesity agents,
5. antiinflammatory active ingredients
6. active ingredients for the treatment of malignant tumors
7. antithrombotic active ingredients
- 10 8. active ingredients for the treatment of high blood pressure
9. active ingredients for the treatment of heart failure and
10. active ingredients for the treatment and/or prevention of complications caused by diabetes or associated with diabetes.
11. active ingredients for the treatment of neurodegenerative diseases
- 15 12. active ingredients for the treatment of disorders of the central nervous system
13. active ingredients for the treatment of drug, nicotine and alcohol addiction
14. analgesics

They can be combined with the compounds of the invention of the formula I in particular for a synergistic enhancement of activity. Administration of the active ingredient combination can take place either by separate administration of the active ingredients to the patient or in the form of combination products in which a plurality of active ingredients are present in one pharmaceutical preparation.

25 Particularly suitable further active ingredients for the combination preparations are: All antidiabetics mentioned in the Rote Liste 2006, Chapter 12; all slimming agents/appetite suppressants mentioned in the Rote Liste 2006, Chapter 1; all lipid-lowering agents mentioned in the Rote Liste 2006, Chapter 58. They can be combined with the compound of the formula I according to the invention in particular for a synergistic enhancement of activity. The active compound combination can be administered either by separate administration of the active compounds to the patient or in the form of combination preparations in which a plurality of active compounds are

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present in a pharmaceutical preparation. Most of the active compounds listed below are disclosed in USP Dictionary of USAN and International Drug Names, US Pharmacopeia, Rockville 2001.

Antidiabetics include insulin and insulin derivatives, such as, for example, Lantus® (see
5 www.lantus.com) or HMR 1964 or those described in WO2005005477 (Novo Nordisk),
fast-acting insulins (see US 6,221,633), inhalable insulins, such as, for example,
Exubera® or oral insulins, such as, for example, IN-105 (Nobex) or Oral-lyn™
(Generex Biotechnology), GLP-1 derivatives, such as, for example, Exenatide,
Liraglutide or those disclosed in WO 98/08871 or WO2005027978 by Novo Nordisk
10 A/S, in WO 01/04156 by Zealand or in WO 00/34331 by Beaufour-Ipsen, pramlintide
acetate (Symlin; Amylin Pharmaceuticals), and also orally effective hypoglycemic
active ingredients.

The active compounds preferably include

- sulfonylureas,
- 15 biguanidines,
- meglitinides,
- oxadiazolidinediones,
- thiazolidinediones,
- glucosidase inhibitors,
- 20 inhibitors of glycogen phosphorylase,
- glucagon antagonists,
- glucokinase activators,
- inhibitors of fructose-1,6-bisphosphatase,
- modulators of the glucose transporter 4 (GLUT4),
- 25 inhibitors of glutamine:fructose-6-phosphate amidotransferase (GFAT),
- GLP-1 agonists,
- potassium channel openers, such as, for example, those disclosed in WO 97/26265
and WO 99/03861 by Novo Nordisk A/S,
- inhibitors of dipeptidylpeptidase IV (DPP-IV),
- 30 insulin sensitizers,

inhibitors of liver enzymes involved in the stimulation of gluconeogenesis and/or glycogenolysis,

modulators of glucose uptake, glucose transport and glucose backresorption,

inhibitors of 11 β -HSD1,

5 inhibitors of protein tyrosine phosphatase 1B (PTP1B),

modulators of the sodium/glucose cotransporter 1 or 2 (SGLT1, SGLT2),

compounds which alter lipid metabolism, such as antihyperlipidemic active ingredients and antilipidemic active ingredients,

compounds which reduce food intake or food absorption,

10 compounds which increase thermogenesis,

PPAR and RXR modulators and

active ingredients which act on the ATP-dependent potassium channel of the beta cells.

15 In one embodiment of the invention, the compound of the formula I is administered in combination with a HMGCoA reductase inhibitor, such as simvastatin, fluvastatin, pravastatin, lovastatin, atorvastatin, cerivastatin, rosuvastatin or L-659699.

20 In one embodiment of the invention, the compound of the formula I is administered in combination with a cholesterol resorption inhibitor, such as, for example, ezetimibe, tiqueside, pamaqueside, FM-VP4 (sitostanol/campesterol ascorbyl phosphate; Forbes Medi-Tech, WO2005042692), MD-0727 (Microbia Inc., WO2005021497) or with compounds as described in WO2002066464 (Kotobuki Pharmaceutical Co. Ltd.), WO2005062824 (Merck & Co.) or WO2005061451 and WO2005061452 (AstraZeneca
25 AB).

In one embodiment of the invention, the compound of the formula I is administered in combination with a PPAR gamma agonist, such as, for example, rosiglitazone, pioglitazone, JTT-501, GI 262570, R-483 or CS-011 (rivoglitazone).

In one embodiment of the invention, the compound of the formula I is administered in combination with a PPAR alpha agonist, such as, for example, GW9578, GW-590735, K-111, LY-674, KRP-101 or DRF-10945.

- 5 In one embodiment of the invention, the compound of the formula I is administered in combination with a mixed PPAR alpha/gamma agonist, such as, for example, muraglitazar, tesaglitazar, naveglitazar, LY-510929, ONO-5129, E-3030 or as described in WO00/64888, WO00/64876, WO03/020269, WO2004075891, WO2004076402, WO2004075815, WO2004076447, WO2004076428,
10 WO2004076401, WO2004076426, WO2004076427, WO2006018118, WO2006018115, and WO2006018116 or in J.P. Berger et al., TRENDS in Pharmacological Sciences 28(5), 244-251, 2005.

- In one embodiment of the invention, the compound of the formula I is administered in
15 combination with a PPAR delta agonist, such as, for example, GW-501516 or as described in WO2005097762, WO2005097786, WO2005097763, and WO2006029699.

- In one embodiment of the invention, the compound of the formula I is administered in
20 combination with metaglidase or with MBX-2044 or other partial PPAR gamma agonists/antagonists.

- In one embodiment of the invention, the compound of the formula I is administered in combination with a fibrate, such as, for example, fenofibrate, clofibrate or bezafibrate.
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- In one embodiment of the invention, the compound of the formula I is administered in combination with an MTP inhibitor, such as, for example, implitapide, BMS-201038, R-103757 or those described in WO2005085226.
- 30 In one embodiment of the invention, the compound of the formula I is administered in combination with a CETP inhibitor, such as, for example, torcetrapib or JTT-705.

In one embodiment of the invention, the compound of the formula I is administered in combination with a bile acid resorption inhibitor (see, for example, US 6,245,744, US 6,221,897 or WO00/61568), such as, for example, HMR 1741 or those described in DE 10 2005 033099.1 and DE 10 2005 033100.9.

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In one embodiment of the invention, the compound of the formula I is administered in combination with a polymeric bile acid adsorber, such as, for example, cholestyramine or colessevelam.

10 In one embodiment of the invention, the compound of the formula I is administered in combination with an LDL receptor inducer (see US 6,342,512), such as, for example, HMR1171, HMR1586 or those described in WO2005097738.

15 In one embodiment, the compound of the formula I is administered in combination with Omacor® (omega-3 fatty acids; highly concentrated ethyl esters of eicosapentaenoic acid and docosahexaenoic acid).

In one embodiment of the invention, the compound of the formula I is administered in combination with an ACAT inhibitor, such as, for example, avasimibe.

20 In one embodiment of the invention, the compound of the formula I is administered in combination with an antioxidant, such as, for example, OPC-14117, probucol, tocopherol, ascorbic acid, β -carotene or selenium.

25 In one embodiment of the invention, the compound of the formula I is administered in combination with a vitamin, such as, for example, vitamin B6 or vitamin B12.

In one embodiment of the invention, the compound of the formula I is administered in combination with a lipoprotein lipase modulator, such as, for example, ibrolipim (NO-1886).

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In one embodiment of the invention, the compound of the formula I is administered in combination with an ATP-citrate lyase inhibitor, such as, for example, SB-204990.

In one embodiment of the invention, the compound of the formula I is administered in combination with a squalene synthetase inhibitor, such as, for example, BMS-188494 or as described in WO2005077907.

- 5 In one embodiment of the invention, the compound of the formula I is administered in combination with a lipoprotein(a) antagonist, such as, for example, gemcabene (CI-1027).

- 10 In one embodiment of the invention, the compound of the formula I is administered in combination with an HM74A receptor agonists, such as, for example, nicotinic acid.

In one embodiment of the invention, the compound of the formula I is administered in combination with a lipase inhibitor, such as, for example, orlistat or cetilistat (ATL-962).

- 15 In one embodiment of the invention, the compound of the formula I is administered in combination with insulin.

In one embodiment of the invention, the compound of the formula I is administered in combination with a sulfonylurea, such as, for example, tolbutamide, glibenclamide, glipizide or glimepiride.

- 20 In one embodiment of the invention, the compound of the formula I is administered in combination with a biguanide, such as, for example, metformin.

In another embodiment of the invention, the compound of the formula I is administered in combination with a meglitinide, such as, for example, repaglinide or nateglinide.

- 25 In one embodiment of the invention, the compound of the formula I is administered in combination with a thiazolidinedione, such as, for example, troglitazone, ciglitazone, pioglitazone, rosiglitazone or the compounds disclosed in WO 97/41097 by Dr. Reddy's Research Foundation, in particular 5-[[4-[(3,4-dihydro-3-methyl-4-oxo-2-quinazolinylmethoxy)phenyl]methyl]-2,4-thiazolidinedione.

In one embodiment of the invention, the compound of the formula I is administered in combination with an α -glucosidase inhibitor, such as, for example, miglitol or acarbose.

In one embodiment of the invention, the compound of the formula I is administered in combination with an active ingredient which acts on the ATP-dependent potassium
5 channel of the beta cells, such as, for example, tolbutamide, glibenclamide, glipizide, glimepiride or repaglinide.

In one embodiment of the invention, the compound of the formula I is administered in combination with more than one of the compounds mentioned above, for example in combination with a sulfonylurea and metformin, a sulfonylurea and acarbose,
10 repaglinide and metformin, insulin and a sulfonylurea, insulin and metformin, insulin and troglitazone, insulin and lovastatin, etc.

In one embodiment of the invention, the compound of the formula I is administered in combination with an inhibitor of glycogen phosphorylase, such as, for example, PSN-
15 357 or FR-258900 or those described in WO2003084922, WO2004007455, WO2005073229-31 or WO2005067932.

In one embodiment of the invention, the compound of the formula I is administered in combination with glucagon receptor antagonists, such as, for example, A-770077,
20 NNC-25-2504 or such as in WO2004100875 or WO2005065680.

In one embodiment of the invention, the compound of the formula I is administered in combination with activators of glucokinase, such as, for example, RO-4389620, LY-
2121260 (WO2004063179), PSN-105, PSN-110, GKA-50 or those described, for
25 example, by Prosidion in WO2004072031, WO2004072066, WO 05103021 or WO 06016178, by Roche in WO 00058293, WO 00183465, WO 00183478, WO 00185706, WO 00185707, WO 01044216, GB 02385328, WO 02008209, WO 02014312, WO 0246173, WO 0248106, DE 10259786, WO 03095438, US 04067939 or WO 04052869, by Novo Nordisk in EP 1532980, WO 03055482, WO 04002481, WO
30 05049019, WO 05066145 or WO 05123132, by Merck/Banyu in WO 03080585, WO03097824, WO 04081001, WO 05063738 or WO 05090332, by Eli Lilly in WO

04063194, or by Astra Zeneca in WO 01020327, WO 03000262, WO 03000267, WO 03015774, WO 04045614, WO 04046139, WO 05044801, WO 05054200, WO 05054233, WO 05056530, WO 05080359, WO 05080360 or WO 05121110.

- 5 In one embodiment of the invention, the compound of the formula I is administered in combination with an inhibitor of gluconeogenesis, such as, for example, FR-225654.

In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of fructose-1,6-bisphosphatase (FBPase), such as, for
10 example, CS-917.

In one embodiment of the invention, the compound of the formula I is administered in combination with modulators of the glucose transporter 4 (GLUT4), such as, for example, KST-48 (D.-O. Lee et al.: *Arzneim.-Forsch. Drug Res.* 54 (12), 835 (2004)).

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In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of glutamine:fructose-6-phosphate amidotransferase (GFAT), as described, for example, in WO2004101528.

- 20 In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of dipeptidylpeptidase IV (DPP-IV), such as, for example, vildagliptin (LAF-237), sitagliptin (MK-0431), saxagliptin ((BMS-477118), GSK-823093, PSN-9301, SYR-322, SYR-619, TA-6666, TS-021, GRC-8200, GW-825964X or as described in WO2003074500, WO2003106456, WO200450658, WO2005058901,
25 WO2005012312, WO2005/012308, PCT/EP2005/007821, PCT/EP2005/008005, PCT/EP2005/008002, PCT/EP2005/008004, PCT/EP2005/008283, DE 10 2005 012874.2 or DE 10 2005 012873.4.

In one embodiment of the invention, the compound of the formula I is administered in
30 combination with inhibitors of 11-beta-hydroxysteroid dehydrogenase-1 (11 β -HSD1), such as, for example, BVT-2733 or those described, for example, in WO200190090-94, WO200343999, WO2004112782, WO200344000, WO200344009,

WO2004112779, WO2004113310, WO2004103980, WO2004112784,
WO2003065983, WO2003104207, WO2003104208, WO2004106294,
WO2004011410, WO2004033427, WO2004041264, WO2004037251,
WO2004056744, WO2004065351, WO2004089367, WO2004089380,
5 WO2004089470-71, WO2004089896, WO2005016877 or WO2005097759.

In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of protein tyrosine phosphatase 1B (PTP1B), as described, for example, in WO200119830-31, WO200117516, WO2004506446, WO2005012295,
10 PCT/EP2005/005311, PCT/EP2005/005321, PCT/EP2005/007151, PCT/EP2005/ or DE 10 2004 060542.4.

In one embodiment of the invention, the compound of the formula I is administered in combination with modulators of the sodium/glucose cotransporter 1 or 2 (SGLT1,
15 SGLT2), such as, for example, KGA-2727, T-1095 and SGL-0010 or as described, for example, in WO2004007517, WO200452903, WO200452902, WO2005121161 , WO2005085237, JP2004359630 or by A. L. Handlon in Expert Opin. Ther. Patents (2005) 15(11), 1531-1540.

20 In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of hormone-sensitive lipase (HSL), such as those described, for example, in WO01/17981, WO01/66531, WO2004035550, WO2005073199 or WO03/051842.

25 In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of acetyl-CoA carboxylase (ACC) such as those described, for example, in WO199946262, WO200372197, WO2003072197 or WO2005044814.

In one embodiment of the invention, the compound of the formula I is administered in
30 combination with an inhibitor of phosphoenolpyruvate carboxykinase (PEPCK), such as those described, for example, in WO2004074288.

In one embodiment of the invention, the compound of the formula I is administered in combination with an inhibitor of glycogen synthase kinase-3 beta (GSK-3 beta), such as those described, for example, in US2005222220, WO2004046117, WO2005085230, WO2005111018, WO2003078403, WO2004022544, WO2003106410, WO2005058908, US2005038023, WO2005009997, US2005026984, WO2005000836, WO2004106343, EP1460075, WO2004014910, WO2003076442, WO2005087727 or WO2004046117.

In one embodiment of the invention, the compound of the formula I is administered in combination with an inhibitor of protein kinase C beta (PKC beta), such as, for example, ruboxistaurin.

In one embodiment of the invention, the compound of the formula I is administered in combination with an endothelin-A receptor antagonist, such as, for example, avosentan (SPP-301).

In one embodiment of the invention, the compound of the formula I is administered in combination with inhibitors of "I-kappaB kinase" (IKK inhibitors), such as those described, for example, in WO2001000610, WO2001030774, WO2004022553 or WO2005097129.

In one embodiment of the invention, the compound of the formula I is administered in combination with modulators of the glucocorticoid receptor as described, for example, in WO2005090336.

In a further embodiment of the invention, the compound of the formula I is administered in combination with CART modulators (see "Cocaine-amphetamine-regulated transcript influences energy metabolism, anxiety and gastric emptying in mice" Asakawa, A. et al.: Hormone and Metabolic Research (2001), 33(9), 554-558); NPY antagonists such as, for example, {4-[(4-aminoquinazolin-2-ylamino)methyl]-cyclohexylmethyl}naphthalene-1-sulfonamide hydrochloride (CGP 71683A); peptide YY 3-36 (PYY3-36) or analogous compounds, such as, for example, CJC-1682 (PYY3-36 conjugated with human serum albumin via Cys34), CJC-1643 (derivative of

PYY3-36 which conjugates in vivo to serum albumin) or those described in WO2005080424;

cannabinoid receptor 1 antagonists, such as, for example, rimonabant, SR147778 or those described, for example, in EP 0656354, WO 00/15609, WO 02/076949,

- 5 WO2005080345, WO2005080328, WO2005080343, WO2005075450, WO2005080357, WO200170700, WO2003026647-48, WO200302776, WO2003040107, WO2003007887, WO2003027069, US6,509,367, WO200132663, WO2003086288, WO2003087037, WO2004048317, WO2004058145, WO2003084930, WO2003084943, WO2004058744, WO2004013120,
- 10 WO2004029204, WO2004035566, WO2004058249, WO2004058255, WO2004058727, WO2004069838, US20040214837, US20040214855, US20040214856, WO2004096209, WO2004096763, WO2004096794, WO2005000809, WO2004099157, US20040266845, WO2004110453, WO2004108728, WO2004000817, WO2005000820, US20050009870,
- 15 WO200500974, WO2004111033-34, WO200411038-39, WO2005016286, WO2005007111, WO2005007628, US20050054679, WO2005027837, WO2005028456, WO2005063761-62, WO2005061509 or WO2005077897;
- MC4 agonists (for example [2-(3a-benzyl-2-methyl-3-oxo-2,3,3a,4,6,7-hexahydro-pyrazolo[4,3-c]pyridin-5-yl)-1-(4-chlorophenyl)-2-oxoethyl]-1-amino-1,2,3,4-tetrahydro-
- 20 naphthalene-2-carboxamide; (WO 01/91752)) or LB53280, LB53279, LB53278 or THIQ, MB243, RY764, CHIR-785, PT-141 or those described in WO2005060985, WO2005009950, WO2004087159, WO2004078717, WO2004078716, WO2004024720, US20050124652, WO2005051391, WO2004112793, WO20050222014, US20050176728, US20050164914, US20050124636,
- 25 US20050130988, US20040167201, WO2004005324, WO2004037797, WO2005042516, WO2005040109, WO2005030797, US20040224901, WO200501921, WO200509184, WO2005000339, EP1460069, WO2005047253, WO2005047251, EP1538159, WO2004072076, WO2004072077 or WO2006024390;
- orexin receptor antagonists (for example 1-(2-methylbenzoxazol-6-yl)-3-
- 30 [1,5]naphthyridin-4-ylurea hydrochloride (SB-334867-A) or those described, for example, in WO200196302, WO200185693, WO2004085403 or WO2005075458);

- histamine H3 receptor agonists (for example 3-cyclohexyl-1-(4,4-dimethyl-1,4,6,7-tetrahydroimidazo[4,5-c]pyridin-5-yl)-propan-1-one oxalic acid salt (WO 00/63208) or those described in WO200064884, WO2005082893);
- CRF antagonists (for example [2-methyl-9-(2,4,6-trimethylphenyl)-9H-1,3,9-triazafluoren-4-yl]dipropylamine (WO 00/66585));
- CRF BP antagonists (for example urocortin);
- urocortin agonists;
- β 3 agonists (such as, for example, 1-(4-chloro-3-methanesulfonylmethylphenyl)-2-[2-(2,3-dimethyl-1H-indol-6-yloxy)ethylamino]ethanol hydrochloride (WO 01/83451));
- 10 MSH (melanocyte-stimulating hormone) agonists;
- MCH (melanin-concentrating hormone) receptor antagonists (such as, for example, NBI-845, A-761, A-665798, A-798, ATC-0175, T-226296, T-71, GW-803430 or those compounds described in WO2003/15769, WO2005085200, WO2005019240, WO2004011438, WO2004012648, WO2003015769, WO2004072025,
- 15 WO2005070898, WO2005070925, WO2006018280, WO2006018279, WO2004039780, WO2003033476, WO2002006245, WO2002002744, WO2003004027 or FR2868780);
- CCK-A agonists (such as, for example, {2-[4-(4-chloro-2,5-dimethoxyphenyl)-5-(2-cyclohexylethyl)-thiazol-2-ylcarbamoyl]-5,7-dimethylindol-1-yl}acetic acid trifluoroacetic
- 20 acid salt (WO 99/15525), SR-146131 (WO 0244150) or SSR-125180);
- serotonin reuptake inhibitors (for example dexfenfluramine);
- mixed serotonin- and noradrenergic compounds (for example WO 00/71549);
- 5-HT receptor agonists, for example 1-(3-ethylbenzofuran-7-yl)piperazine oxalic acid salt (WO 01/09111);
- 25 5-HT2C receptor agonists (such as, for example, APD-356, BVT-933 or those described in WO200077010, WO20077001-02, WO2005019180, WO2003064423, WO200242304 or WO2005082859);
- 5-HT6 receptor antagonists, such as described, for example, in WO2005058858;
- bombesin receptor agonists (BRS-3 agonists);
- 30 galanin receptor antagonists;
- growth hormone (for example human growth hormone or AOD-9604);

growth hormone releasing compounds (tert-butyl 6-benzyloxy-1-(2-diisopropylamino-ethylcarbamoyl)-3,4-dihydro-1H-isoquinoline-2-carboxylate (WO 01/85695));

growth hormone secretagog receptor antagonists (ghrelin antagonists) such as, for example, A-778193 or those described in WO2005030734;

5 TRH agonists (see, for example, EP 0 462 884);

uncoupling protein 2 or 3 modulators;

leptin agonists (see for example Lee, Daniel W.; Leinung, Matthew C.; Rozhavskaya-Arena, Marina; Grasso, Patricia. Leptin agonists as a potential approach to the treatment of obesity. *Drugs of the Future* (2001), 26(9), 873-881);

10 DA agonists (bromocriptine or Doprexin);

lipase/amylase inhibitors (as described, for example, in WO 00/40569);

inhibitors of diacylglycerol O-acyltransferases (DGATs) such as described, for example, in US2004/0224997, WO2004094618, WO200058491, WO2005044250, WO2005072740, JP2005206492 or WO2005013907;

15 inhibitors of fatty acid synthase (FAS) such as, for example, C75 or those described in WO2004005277;

oxyntomodulin;

oleoyl-estrone

20 or thyroid hormone receptor agonists, such as, for example, KB-2115 or those described in WO20058279, WO200172692, WO200194293, WO2003084915, WO2004018421 or WO2005092316.

In one embodiment of the invention, the further active ingredient is leptin;

25 see for example "Perspectives in the therapeutic use of leptin", Salvador, Javier; Gomez-Ambrosi, Javier; Fruhbeck, Gema, *Expert Opinion on Pharmacotherapy* (2001), 2(10), 1615-1622.

In one embodiment of the invention, the further active ingredient is dexamphetamine or
30 amphetamine.

In one embodiment of the invention, the further active ingredient is fenfluramine or dexfenfluramine.

In another embodiment of the invention, the further active ingredient is sibutramine.

5 In one embodiment of the invention, the further active ingredient is mazindol or phentermine.

In one embodiment, the compounds of the formula I are administered in combination with bulking agents, preferably insoluble bulking agents (see, for example, carob/Caromax[®] (Zunft H J; et al., Carob pulp preparation for treatment of
10 hypercholesterolemia, ADVANCES IN THERAPY (2001 Sep-Oct), 18(5), 230-6). Caromax is a carob-containing product from Nutrinova, Nutrition Specialties & Food Ingredients GmbH, Industriepark Höchst, 65926 Frankfurt/Main). Combination with Caromax[®] is possible in one preparation or by separate administration of compounds of the formula I and Caromax[®]. Caromax[®] can in this connection also be administered
15 in the form of food products such as, for example, in bakery products or muesli bars.

In one embodiment of the invention, the compound of the formula I is administered in combination with PDE (phosphodiesterase) inhibitors, as described, for example, in
20 WO2003/077949 or WO2005012485.

In one embodiment of the invention, the compound of the formula I is administered in combination with NAR-1 (nicotinic acid receptor) agonists as described, for example, in
WO2004094429.

25 In one embodiment of the invention, the compound of the formula I is administered in combination with CB2 (cannabinoid receptor) agonists as described, for example, in US2005/143448.

In one embodiment of the invention, the compound of the formula I is administered in
30 combination with histamine 1 agonists as described, for example, in WO2005101979.

In one embodiment of the invention, the compound of the formula I is administered in combination with bupropion, as described in WO2006017504.

5 In one embodiment of the invention, the compound of the formula I is administered in combination with opioid antagonists as described, for example, in WO2005107806 or WO2004094429.

10 In one embodiment of the invention, the compound of the formula I is administered in combination with neutral endopeptidase inhibitors as described, for example, in WO200202513, WO2002/06492, WO 2002040008, WO2002040022 or WO2002047670.

15 In one embodiment of the invention, the compound of the formula I is administered in combination with NPY inhibitors (neuropeptide Y) as described, for example, in WO2002047670.

20 In one embodiment of the invention, the compound of the formula I is administered in combination with sodium/hydrogen exchange inhibitors as described, for example, in WO2003092694.

In one embodiment of the invention, the compound of the formula I is administered in combination with modulators of the glucocorticoid receptor as described, for example, in WO2005090336.

25 In one embodiment of the invention, the compound of the formula I is administered in combination with nicotine receptor agonists as described, for example, in WO2004094429.

30 In one embodiment of the invention, the compound of the formula I is administered in combination with NRIs (norepinephrine reuptake inhibitors) as described, for example, in WO2002053140.

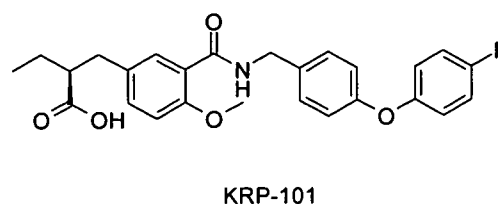
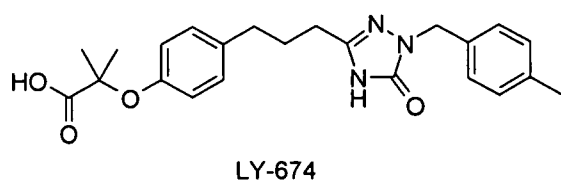
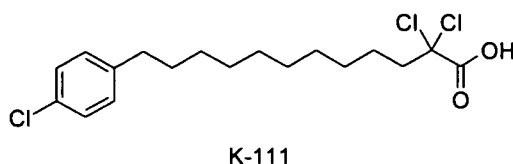
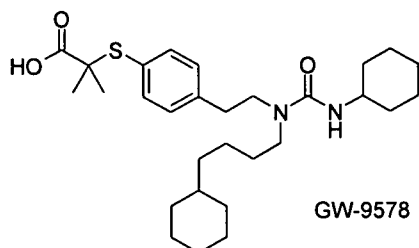
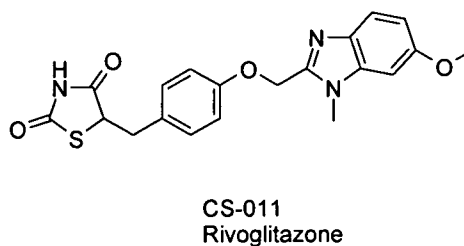
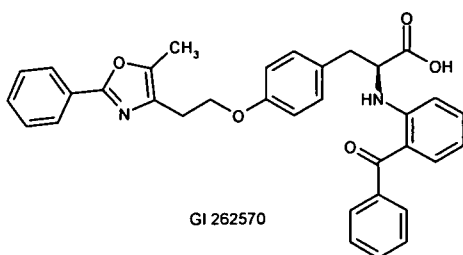
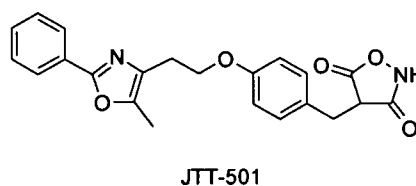
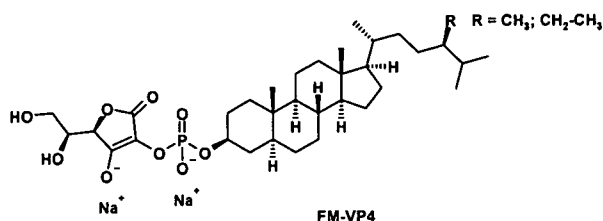
In one embodiment of the invention, the compound of the formula I is administered in combination with MOA (E-beta-methoxyacrylate), such as, for example, segeline, or as described, for example, in WO2002053140.

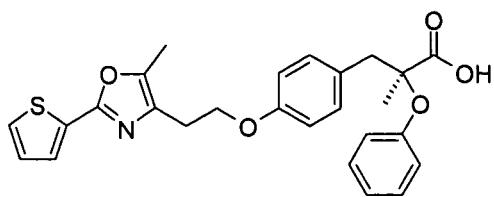
- 5 In one embodiment of the invention, the compound of the formula I is administered in combination with antithrombotic active ingredients, such as, for example, clopidogrel.

10 It is to be understood that each suitable combination of the compounds according to the invention with one or more of the compounds mentioned above and optionally one or more further pharmacologically active substances is meant to be included in the scope of the present invention.

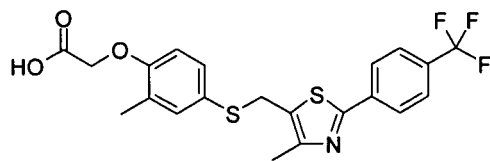
The formulae for some of the development codes mentioned above are given below.

15

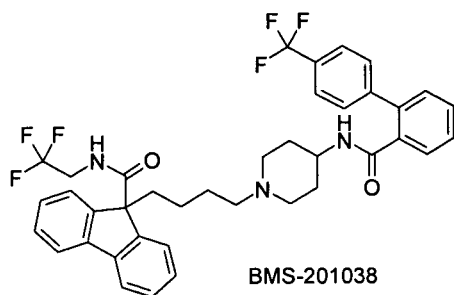




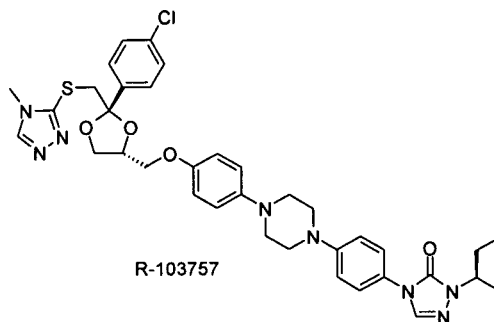
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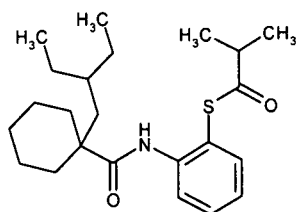
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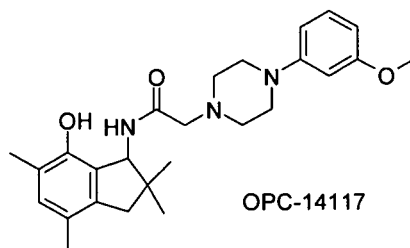
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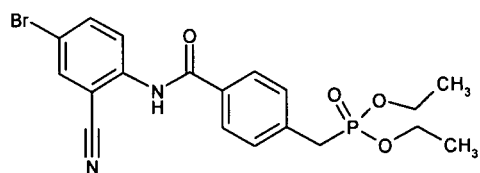
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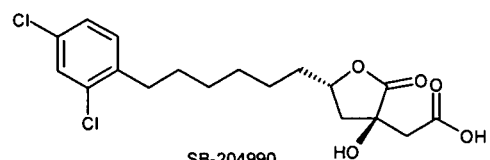
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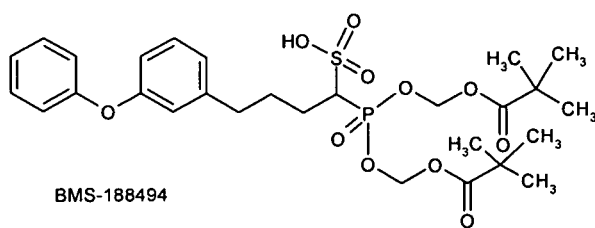
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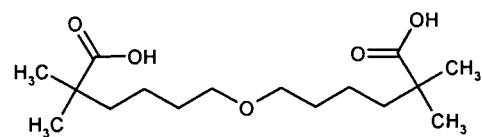
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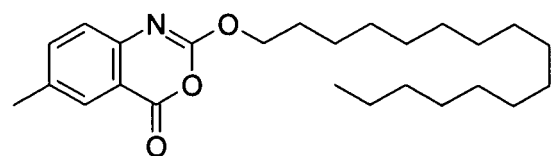
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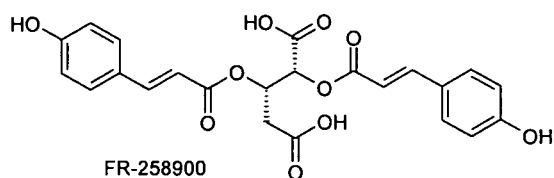
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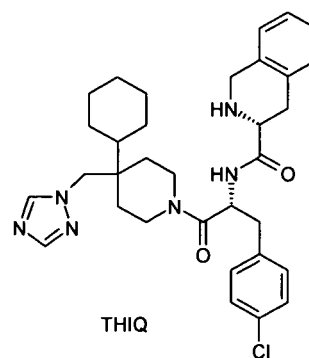
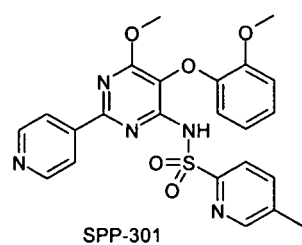
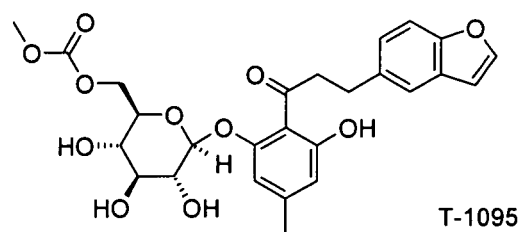
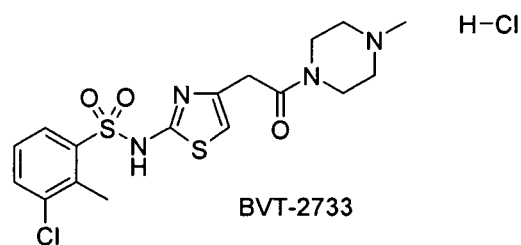
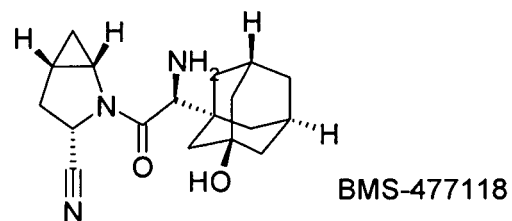
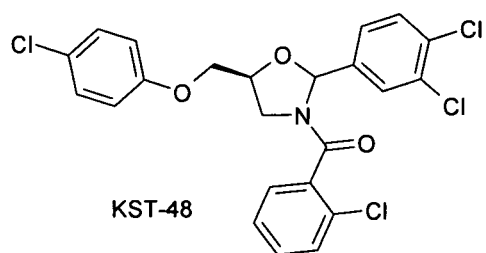
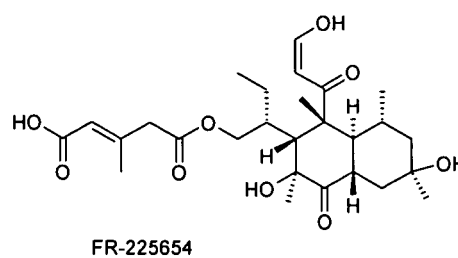
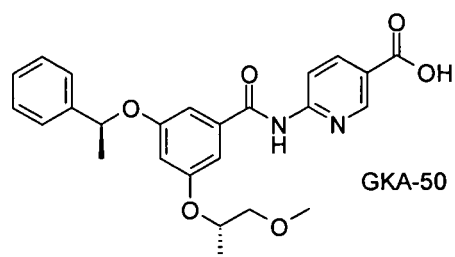
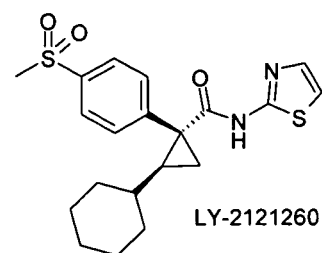
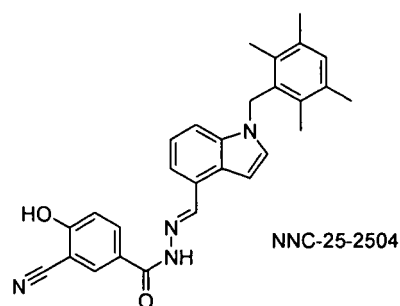
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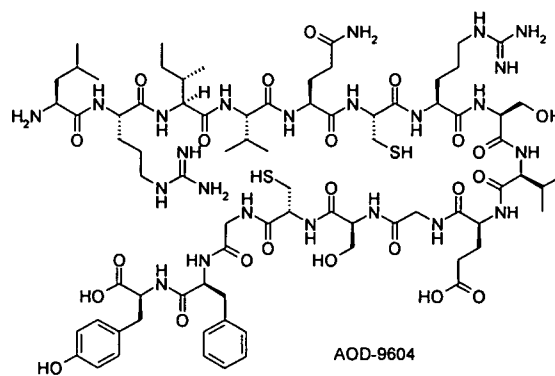
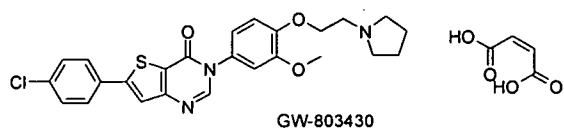
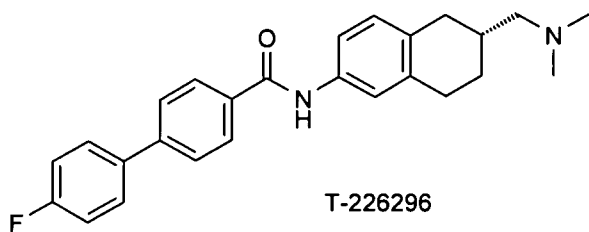
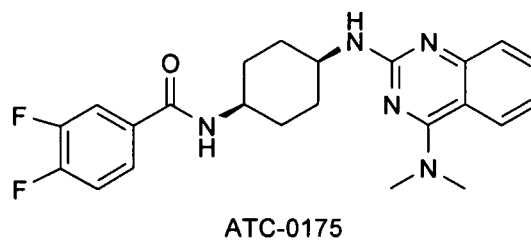
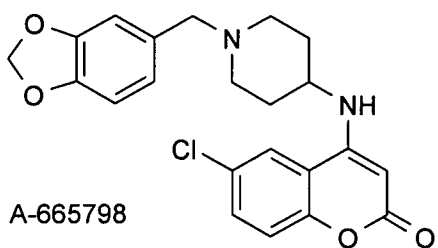
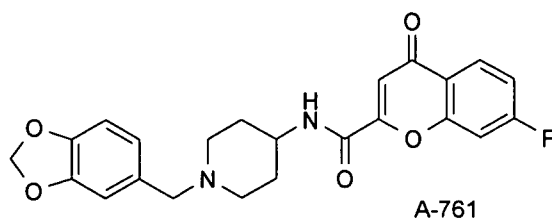
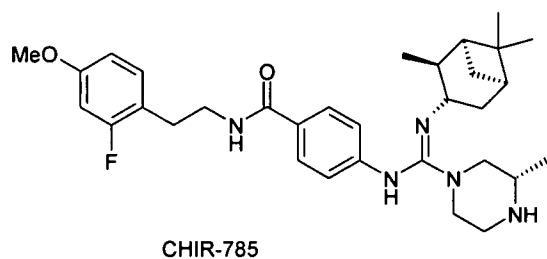
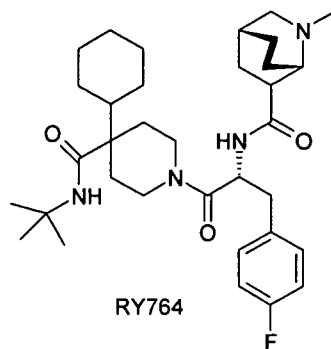
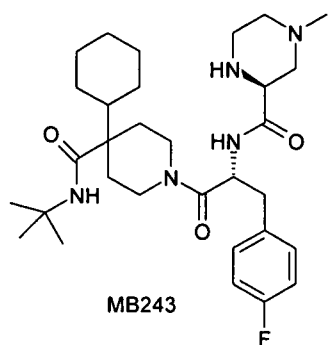


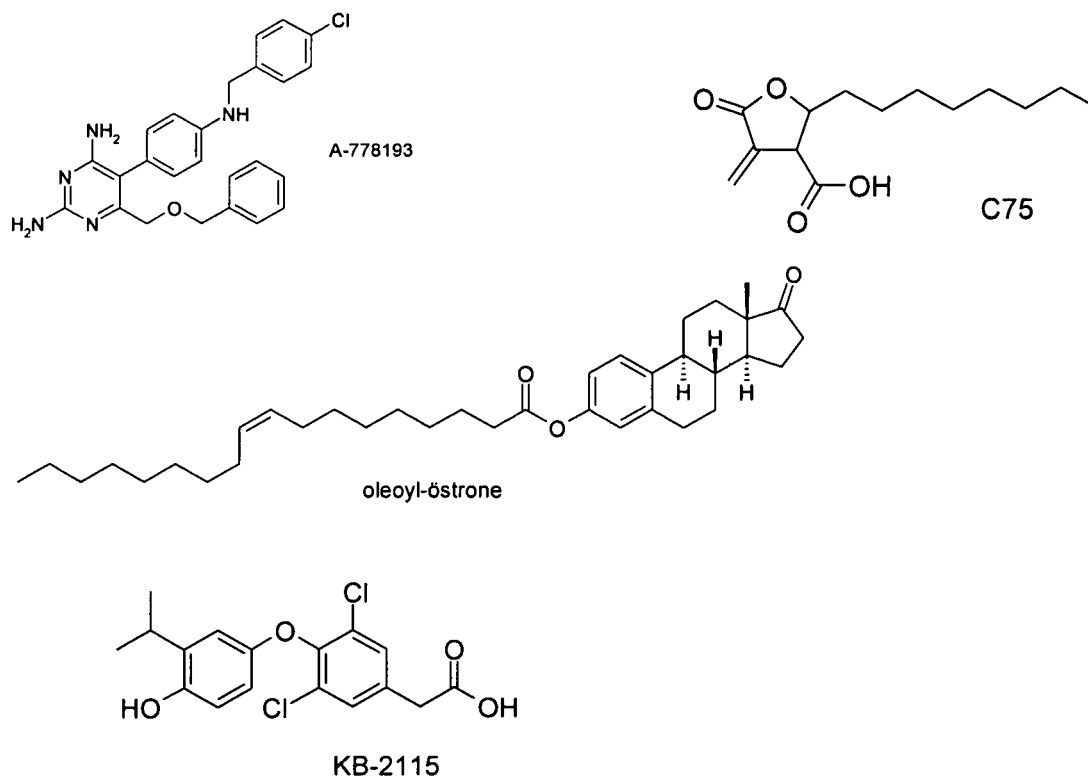
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5

The activity of the compounds was tested as follows:

Determination of EC₅₀ values of PPAR agonists in the cellular PPARalpha assay

10

Principle

The potency of substances which bind to human PPARalpha and activate it in an agonistic manner is analyzed using a stably transfected HEK cell line (HEK= human embryo kidney) which is referred to here as PPARalpha reporter cell line. It contains two genetic elements, a luciferase reporter element (pdeltaM-GAL4-Luc-Zeo) and a PPARalpha fusion protein (GR-GAL4-humanPPARalpha-LBD) which mediates expression of the luciferase reporter element depending on a PPARalpha ligand. The stably and constitutively expressed fusion protein GR-GAL4-humanPPARalpha-LBD binds in the cell nucleus of the PPARalpha reporter cell line via the GAL4 protein portion to the GAL4 DNA binding motifs 5'-upstream of the luciferase reporter element

20

which is stably integrated in the genome of the cell line. There is only weak expression of the luciferase reporter gene in the absence of a PPARalpha ligand if fatty acid-depleted fetal calf serum (cs-FCS) is used in the assay. PPARalpha ligands bind and activate the PPARalpha fusion protein and thereby stimulate the expression of the luciferase reporter gene. The luciferase which is formed can be detected by means of chemiluminescence via an appropriate substrate.

Construction of the PPARalpha reporter cell line

The PPARalpha reporter cell line was prepared in two stages. Firstly, the luciferase reporter element was constructed and stably transfected into HEK cells. For this purpose, five binding sites of the yeast transcription factor GAL4 (Accession # AF264724) were cloned in 5'-upstream of a 68 bp-long minimal MMTV promoter (Accession # V01175). The minimal MMTV promoter section contains a CCAAT box and a TATA element in order to enable efficient transcription by RNA polymerase II. The cloning and sequencing of the GAL4-MMTV construct took place in analogy to the description of Sambrook J. et. al. (Molecular cloning, Cold Spring Harbor Laboratory Press, 1989). Then the complete Photinus pyralis gene (Accession # M15077) was cloned in 3'-downstream of the GAL4-MMTV element. After sequencing, the luciferase reporter element consisting of five GAL4 binding sites, MMTV promoter and luciferase gene was recloned into a plasmid which confers zeocin resistance in order to obtain the plasmid pdeltaM-GAL4-Luc-Zeo. This vector was transfected into HEK cells in accordance with the statements in Ausubel, F.M. et al. (Current protocols in molecular biology, Vol. 1-3, John Wiley & Sons, Inc., 1995). Then zeocin-containing medium (0.5 mg/ml) was used to select a suitable stable cell clone which showed very low basal expression of the luciferase gene.

In a second step, the PPARalpha fusion protein (GR-GAL4-humanPPARalpha-LBD) was introduced into the stable cell clone described. For this purpose, initially the cDNA coding for the N-terminal 76 amino acids of the glucocorticoid receptor (Accession # P04150) was linked to the cDNA section coding for amino acids 1-147 of the yeast transcription factor GAL4 (Accession # P04386). The cDNA of the ligand-binding domain of the human PPARalpha receptor (amino acids S167-Y468; Accession #

S74349) was cloned in at the 3'-end of this GR-GAL4 construct. The fusion construct prepared in this way (GR-GAL4-humanPPARalpha-LBD) was recloned into the plasmid pcDNA3 (Invitrogen) in order to enable constitutive expression therein by the cytomegalovirus promoter. This plasmid was linearized with a restriction endonuclease and stably transfected into the previously described cell clone containing the luciferase reporter element. The finished PPARalpha reporter cell line which contains a luciferase reporter element and constitutively expresses the PPARalpha fusion protein (GR-GAL4-human PPARalpha-LBD) was isolated by selection with zeocin (0.5 mg/ml) and G418 (0.5 mg/ml).

Assay procedure

The activity of PPARalpha agonists is determined in a 3-day assay which is described below:

Day 1

The PPARalphareporter cell line is cultivated to 80% confluence in DMEM (# 41965-039, Invitrogen) which is mixed with the following additions: 10% cs-FCS (fetal calf serum; #SH-30068.03, Hyclone), 0.5 mg/ml zeocin (#R250-01, Invitrogen), 0.5 mg/ml G418 (#10131-027, Invitrogen), 1% penicillin-streptomycin solution (#15140-122, Invitrogen) and 2 mM L-glutamine (#25030-024, Invitrogen). The cultivation takes place in standard cell culture bottles (# 353112, Becton Dickinson) in a cell culture incubator at 37°C in the presence of 5% CO₂. The 80%-confluent cells are washed once with 15 ml of PBS (#14190-094, Invitrogen), treated with 3 ml of trypsin solution (#25300-054, Invitrogen) at 37°C for 2 min, taken up in 5 ml of the DMEM described and counted in a cell counter. After dilution to 500.000 cells/ml, 35,000 cells are seeded in each well of a 96 well microtiter plate with a clear plastic base (#3610, Corning Costar). The plates are incubated in the cell culture incubator at 37°C and 5% CO₂ for 24 h.

Day 2

PPARalpha agonists to be tested are dissolved in DMSO in a concentration of 10 mM.

This stock solution is diluted in DMEM (#41965-039, Invitrogen) which is mixed with 5% cs-FCS (#SH-30068.03, Hyclone), 2 mM L-glutamine (#25030-024, Invitrogen) and the previously described antibiotics (zeocin, G418, penicillin and streptomycin).

Test substances are tested in 11 different concentrations in the range from 10 μ M to 100 pM. More potent compounds are tested in concentration ranges from 1 μ M to 10 pM or between 100 nM and 1 pM.

The medium of the PPARalpha reporter cell line seeded on day 1 is completely removed by aspiration, and the test substances diluted in medium are immediately added to the cells. The dilution and addition of the substances is carried out by a robot (Beckman FX). The final volume of the test substances diluted in medium is 100 μ l per well of a 96 well microtiter plate. The DMSO concentration in the assay is less than 0.1 % v/v in order to avoid cytotoxic effects of the solvent.

Each plate was charged with a standard PPARalpha agonist, which was likewise diluted in 11 different concentrations, in order to demonstrate the functioning of the assay in each individual plate. The assay plates are incubated in an incubator at 37°C and 5% CO₂ for 24 h.

Day 3

The PPARalpha reporter cells treated with the test substances are removed from the incubator, and the medium is aspirated off. The cells are lysed by pipetting 50 μ l of Bright Glo reagent (from Promega) into each well of a 96 well microtiter plate. After incubation at room temperature in the dark for 10 minutes, the microtiter plates are measured in the luminometer (Trilux from Wallac). The measuring time for each well of a microtiter plate is 1 sec.

Evaluation

The raw data from the luminometer are transferred into a Microsoft Excel file. Dose-effect plots and EC₅₀ values of PPAR agonists are calculated using the XL.Fit program as specified by the manufacturer (IDBS).

Determination of EC₅₀ values of PPAR agonists in the cellular PPARdelta assay

Principle

The potency of substances which bind to human PPARdelta and activate it in an agonistic manner is analyzed using a stably transfected HEK cell line (HEK= human embryo kidney) which is referred to here as PPARdelta reporter cell line. In analogy to the assay described for PPARalpha, the PPARdelta reporter cell line also contains two genetic elements, a luciferase reporter element (pdeltaM-GAL4-Luc-Zeo) and a PPARdelta fusion protein (GR-GAL4-humanPPARdelta-LBD) which mediates expression of the luciferase reporter element depending on a PPARdelta ligand. The stably and constitutively expressed fusion protein GR-GAL4-humanPPARdelta-LBD binds in the cell nucleus of the PPARdelta reporter cell line via the GAL4 protein portion to the GAL4 DNA binding motifs 5'-upstream of the luciferase reporter element which is stably integrated in the genome of the cell line. There is only little expression of the luciferase reporter gene in the absence of a PPARdelta ligand if fatty acid-depleted fetal calf serum (cs-FCS) is used in the assay. PPARdelta ligands bind and activate the PPARdelta fusion protein and thereby stimulate expression of the luciferase reporter gene. The luciferase which is formed can be detected by means of chemiluminescence via an appropriate substrate.

Construction of the PPARdelta reporter cell line

The production of the stable PPARdelta reporter cell line is based on a stable HEK-cell clone which was stably transfected with a luciferase reporter element. This step was already described above in the section "construction of the PPARalpha reporter cell line". In a second step, the PPARdelta fusion protein (GR-GAL4-humanPPARdelta-LBD) was stably introduced into this cell clone. For this purpose, the cDNA coding for the N-terminal 76 amino acids of the glucocorticoid receptor (Accession # P04150) was linked to the cDNA section coding for amino acids 1-147 of the yeast transcription factor GAL4 (Accession # P04386). The cDNA of the ligand-binding domain of the human PPARdelta receptor (amino acids S139-Y441; Accession # L07592) was cloned in at the 3'-end of this GR-GAL4 construct. The fusion construct prepared in this way (GR-GAL4-humanPPARdelta-LBD) was recloned into the plasmid pcDNA3

(Invitrogen) in order to enable constitutive expression by the cytomegalovirus promoter. This plasmid was linearized with a restriction endonuclease and stably transfected into the previously described cell clone containing the luciferase reporter element. The resulting PPARdelta reporter cell line which contains a luciferase reporter element and constitutively expresses the PPARdelta fusion protein (GR-GAL4-human PPARdelta-LBD) was isolated by selection with zeocin (0.5 mg/ml) and G418 (0.5 mg/ml).

Assay procedure and evaluation

The activity of PPARdelta agonists is determined in a 3-day assay in exact analogy to the procedure already described for the PPARalpha reporter cell line except that the PPARdelta reporter cell line and a specific PPARdelta agonist was used as a standard to control test efficacy.

PPARdelta EC₅₀ values in the range from 1 nM to >10 µM were measured for the PPAR agonists of Examples 1 to 8 described in this application. Compounds of the invention of the formula I activate the PPARdelta receptor.

Determination of EC₅₀ values of PPAR agonists in the cellular PPARgamma assay

Principle

A transient transfection system is employed to determine the cellular PPARgamma activity of PPAR agonists. It is based on the use of a luciferase reporter plasmid (pGL3basic-5xGAL4-TK) and of a PPARgamma expression plasmid (pcDNA3-GAL4-humanPPARgammaLBD). Both plasmids are transiently transfected into human embryonic kidney cells (HEK cells). There is then expression in these cells of the fusion protein GAL4-humanPPARgammaLBD which binds to the GAL4 binding sites of the reporter plasmid. In the presence of a PPARgamma-active ligand, the activated fusion protein GAL4-humanPPARgammaLBD induces expression of the luciferase

reporter gene, which can be detected in the form of a chemiluminescence signal after addition of a luciferase substrate. As a difference from the stably transfected PPARalpha reporter cell line, in the cellular PPARgamma assay the two components (luciferase reporter plasmid and PPARgamma expression plasmid) are transiently transfected into HEK cells because stable and permanent expression of the PPARgamma fusion protein is cytotoxic.

Construction of the plasmids

The luciferase reporter plasmid pGL3basic-5xGAL4-TK is based on the vector pGL3basic from Promega. The reporter plasmid is prepared by cloning five binding sites of the yeast transcription factor GAL4 (each binding site with the sequence 5'-CTCGGAGGACAGTACTCCG-3'), together with a 160 bp-long thymidine kinase promoter section (Genbank Accession # AF027128) 5'-upstream into pGL3basic. 3'-downstream of the thymidine kinase promoter is the complete luciferase gene from *Photinus pyralis* (Genbank Accession # M15077) which is already a constituent of the plasmid pGL3basic used. The cloning and sequencing of the reporter plasmid pGL3basic-5xGAL4-TK took place in analogy to the description in Sambrook J. et. al. (Molecular cloning, Cold Spring Harbor Laboratory Press, 1989).

The PPARgamma expression plasmid pcDNA3-GAL4-humanPPARgammaLBD was prepared by first cloning the cDNA coding for amino acids 1-147 of the yeast transcription factor GAL4 (Genbank Accession # P04386) into the plasmid pcDNA3 (from Invitrogen) 3'-downstream of the cytomegalovirus promoter. Subsequently, the cDNA of the ligand-binding domain (LBD) of the human PPARgamma receptor (amino acids I152-Y475; Accession # g1480099) 3'-downstream of the GAL4 DNA binding domain. Cloning and sequencing of the PPARgamma expression plasmid pcDNA3-GAL4-humanPPARgammaLBD again took place in analogy to the description in Sambrook J. et. al. (Molecular cloning, Cold Spring Harbor Laboratory Press, 1989). Besides the luciferase reporter plasmid pGL3basic-5xGAL4-TK and the PPARgamma expression plasmid pcDNA3-GAL4-humanPPARgammaLBD, also used for the cellular PPARgamma assay are the reference plasmid pRL-CMV (from Promega) and the plasmid pBluescript SK(+) from Stratagene. All four plasmids were prepared using a

plasmid preparation kit from Qiagen, which ensured a plasmid quality with a minimal endotoxin content, before transfection into HEK cells.

Assay procedure

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The activity of PPARgamma agonists is determined in a 4-day assay which is described below. Before the transfection, HEK cells are cultivated in DMEM (# 41965-039, Invitrogen) which is mixed with the following additions: 10% FCS (#16000-044, Invitrogen), 1% penicillin-streptomycin solution (#15140-122, Invitrogen) and 2 mM L-glutamine (#25030-024, Invitrogen).

10

Day 1

Firstly, solution A, a transfection mixture which contains all four plasmids previously described in addition to DMEM, is prepared. The following amounts are used to make up 3 ml of solution A for each 96 well microtiter plate for an assay: 2622 µl of antibiotic- and serum-free DMEM (# 41965-039, Invitrogen), 100 µl of reference plasmid pRL-CMV (1 ng/µl), 100 µl of luciferase reporter plasmid pGL3basic-5xGAL4-TK (10 ng/µl), 100 µl of PPARgamma expression plasmid pcDNA3-GAL4-humanPPARgammaLBD (100 ng/µl) and 78 µl of plasmid pBluescript SK(+) (500 ng/µl). Then 2 ml of solution B are prepared by mixing 1.9 ml of DMEM (# 41965-039, Invitrogen) with 100 µl of PolyFect transfection reagent (from Qiagen) for each 96 well microtiter plate. Subsequently, 3 ml of solution A are mixed with 2 ml of solution B to give 5 ml of solution C, which is thoroughly mixed by multiple pipetting and incubated at room temperature for 10 min.

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80%-confluent HEK cells from a cell culture bottle with a capacity of 175 cm² are washed once with 15 ml of PBS (#14190-094, Invitrogen) and treated with 3 ml of trypsin solution (#25300-054, Invitrogen) at 37°C for 2 min. The cells are then taken up in 15 ml of DMEM (# 41965-039, Invitrogen) which is mixed with 10% FCS (# 16000-044, Invitrogen), 1% penicillin-streptomycin solution (#15140-122, Invitrogen) and 2 mM L-glutamine (#25030-024, Invitrogen). After the cell suspension has been counted in a cell counter, the suspension is diluted to 250,000 cells/ml. 15 ml of this cell suspension are mixed with 5 ml of solution C for one microtiter plate. 200 µl of the

suspension are seeded in each well of a 96 well microtiter plate with a clear plastic base (#3610, Corning Costar). The plates are incubated in a cell culture incubator at 37°C and 5% CO₂ for 24 h.

5 Day 2

PPAR agonists to be tested are dissolved in DMSO in a concentration of 10 mM. This stock solution is diluted in DMEM (# 41965-039, Invitrogen) which is mixed with 2% Ultrosor (#12039-012, Biosepra), 1% penicillin-streptomycin solution (#15140-122, Invitrogen) and 2 mM L-glutamine (#25030-024, Invitrogen). Test substances are

10 tested in a total of 11 different concentrations in the range from 10 µM to 100 pM. More potent compounds are tested in concentration ranges from 1 µM to 10 pM.

The medium of the HEK cells transfected and seeded on day 1 is completely removed by aspiration, and the test substances diluted in medium are immediately added to the cells. The dilution and addition of the substances is carried out by a robot (Beckman

15 FX). The final volume of the test substances diluted in medium is 100 µl per well of a 96 well microtiter plate. Each plate is charged with a standard PPARgamma agonist, which is likewise diluted in 11 different concentrations, in order to demonstrate the functioning of the assay in each individual plate. The assay plates are incubated in an incubator at 37°C and 5% CO₂.

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Day 4

After removal of the medium by aspiration, 50 µl of Dual-Glo™ reagent (Dual-Glo™ Luciferase Assay System; Promega) are added to each well in accordance with the manufacturer's instructions in order to lyse the cells and provide the substrate for the

25 firefly luciferase (*Photinus pyralis*) formed in the cells. After incubation at room temperature in the dark for 10 minutes, the firefly luciferase-mediated

chemiluminescence is measured in a measuring instrument (measuring time/well

1 sec; Trilux from Wallac). Then 50 µl of the Dual-Glo™ Stop & Glo reagent (Dual-Glo™ Luciferase Assay System; Promega) is added to each well in order to stop the

30 activity of the firefly luciferase and provide the substrate for the Renilla luciferase expressed by the reference plasmid pRL-CMV. After incubation at room temperature in the dark for a further 10 minutes, a chemiluminescence mediated by the Renilla

luciferase is again measured for 1 sec/well in the measuring instrument.

Evaluation

- 5 The crude data from the luminometer are transferred into a Microsoft Excel file. The firefly/Renilla luciferase activity ratio is determined for each measurement derived from one well of the microtiter plate. The dose-effect plots and EC50 values of PPAR agonists are calculated from the ratios by the XL.Fit program as specified by the manufacturer (IDBS).

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PPARgamma EC50 values in the range from 1 nM to >10 μ M were measured for the PPAR agonists of Examples 1 to 8 described in this application. Compounds of the invention of the formula I activate the PPARgamma receptor.

- 15 The examples given in Table I serve to illustrate the invention, but without limiting it.

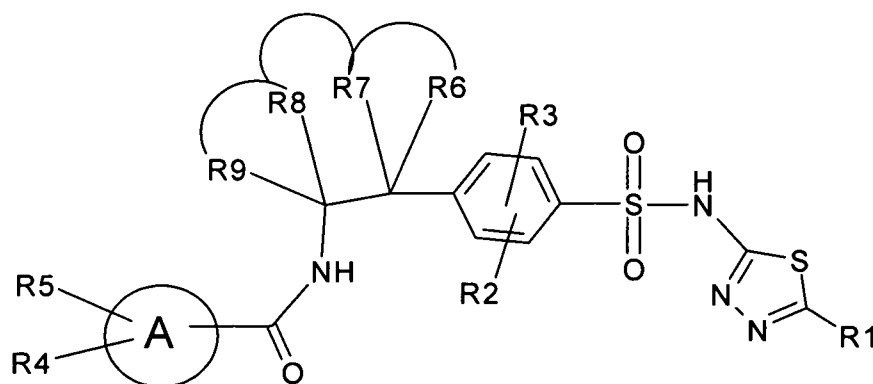


Table I

- 20 where R2, R3, R9 = H ,
and a dotted line means the point of attachment to the amide.

Example	R1	A	R4	R5	R6	R7	R8
1	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	-(CH ₂) ₅ -		H
2	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	H	-(CH ₂) ₄ - trans	
3	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	H	-(CH ₂) ₄ - cis	
4	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	-(CH ₂) ₄ -		H
5	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	H	-CH ₂ - trans	
6	-CH(CH ₃) ₂		2-OCH ₂ CH ₃	4-CF ₃	-(CH ₂) ₃ -		H
7	-CH(CH ₃) ₂		3-OCH ₂ CH ₃	5-CF ₃	-(CH ₂) ₃ -		H
8	-CF ₃		2-OCH ₂ CH ₃	4-CF ₃	-(CH ₂) ₄ -		H

The potency of some of the described examples are indicated in the following table :

5

Example	PPARdelta EC ₅₀ (μM)	PPARgamma EC ₅₀ (μM)
1	0,12	>10
2	0,026	0,43
3	0,24	0,23
4	0,021	0,007

Processes

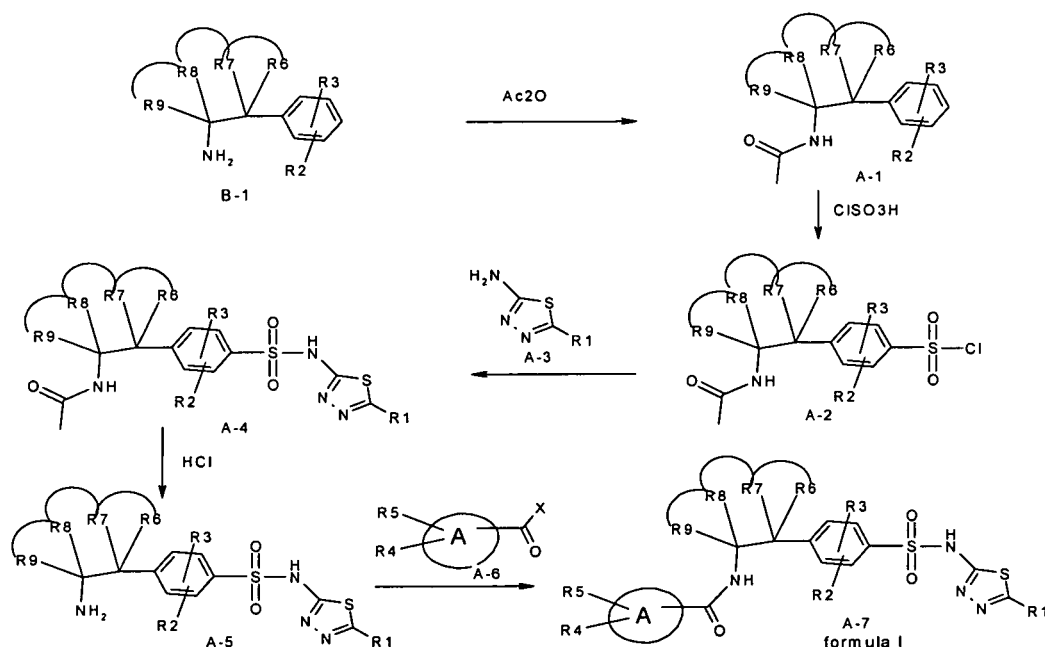
The compounds of the general formula I according to the invention can be obtained as outlined to the reaction schemes below:

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Process A

This process is used for synthesizing compounds of general formula A-7, where A, n, R1, R3, R4, R5, R6, R7, R8 and R9 are as defined above.

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An acetamide of general formula A-1 where R2, R3, R6, R7, R8 and R9 are as defined above, prepared from the amine of the general formula B-1, is treated with chlorosulfonic acid to obtain the benzenesulfonyl chloride of general formula A-2. The benzenesulfonyl chloride of general formula A-2 is coupled with the [1,3,4]thiadiazol-2-amine of general formula A-3, where R1 is as defined above in pyridine with a catalytic amount of N,N-dimethylaminopyridine to obtain the sulfonyl amide of general formula A-4. Upon refluxing in 2N hydrochloric acid the N-acetyl group is removed to obtain the amine of general formula A-5 as its hydrochloric acid salt.

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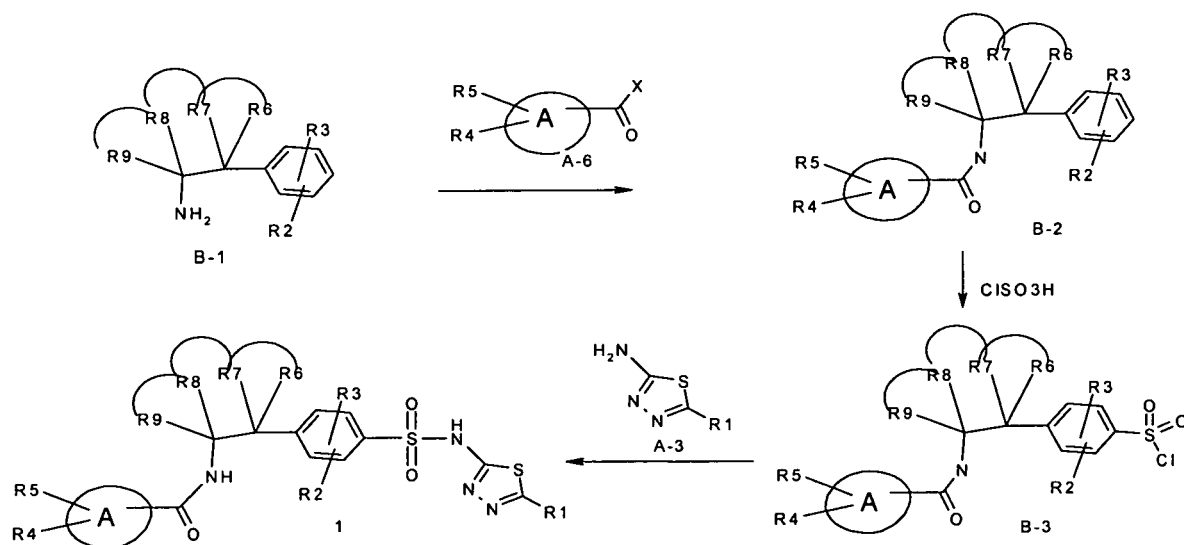
The amine of general formula A-5 is coupled with a carboxylic acid of general formula

A-6, where X = OH and A, R4, R5 are as defined above, with a coupling reagent as O-((ethoxycarbonyl)cyanomethyleneamino)-N,N,N',N'-tetramethyluronium tetrafluoroborat in the presence of a base like triethylamine in a solvent such as dimethylformamide to obtain a compound of general formula I. Alternatively the amine of general formula A-5 is coupled with a carbonyl chloride of general formula A-6, where X = Cl in a solvent such as dichloromethane to obtain a compound of general formula I.

Other compounds can be obtained accordingly or by known processes.

Process B:

This process can be used alternatively for synthesizing compounds of general formula I, where A, n, R1, R2, R3, R4, R5, R6, R7, R8 and R9 are as defined above.



An amine of general formula B-1, where R2, R3, R6, R7, R8 and R9 are as defined above is coupled with a carboxylic acid of general formula A-6, where X = OH and A, R4, R5 are as defined above, with a coupling reagent such as O-((ethoxycarbonyl)cyanomethyleneamino)-N,N,N',N'-tetramethyluronium - tetrafluoroborat in the presence of a base as triethylamine in a solvent as dimethylformamide to obtain a compound of general formula B-2. Alternatively the amine of general formula B-1 is coupled with a carbonyl chloride of general formula A-6, where X = Cl and A, R4, R5 are as defined above in a solvent as dichloromethane to

- 5 obtain a compound of general formula B-2. The compound of general formula B-2 is treated with chlorosulfonic acid to obtain the benzenesulfonyl chloride of general formula B-3. The benzenesulfonyl chloride of general formula B-3 is coupled with the [1,3,4]thiadiazol-2-ylamine of general formula A-3, where R1 is as defined above, in pyridine with a catalytic amount of N,N-dimethylaminopyridine to obtain the compound of the general formula I.

List of abbreviation:

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Ac	acetyl
AIBN	2,2'-azobis(2-methylpropionitrile)
Bn	benzyl
BOC	tert-butyl-oxy-carbonyl
iBu	isobutyl
tBu	tert-butyl
BuLi	n-butyllithium
Bz	benzoyl
Cy	cyclohexyl
DBU	1,8-diazabicyclo[5.4.0]undec-7-ene
DCI	direct chemical ionization (MS)
DCM	dichloromethane
DMAP	N,N-dimethylaminopyridine
DMF	N,N-dimethylformamide
DMSO	dimethylsulfoxide
EE	ethyl acetate

eq	equivalents
ESI	electrospray-ionisation (MS)
FG	leaving group
GC	gas chromatography
Hal	halogen
HPLC	high performance liquid chromatography
LC-MS	liquid chromatography coupled with mass-spectroscopy
Me	methyl
MeCN	acetonitrile
MS	mass-spectroscopy
MS 4A	molecular sieves four angström
MsCl	methansulfonylchloride
MW	micro wave
NBS	N-bromosuccinimide
NMR	nuclear magnetic resonance
p	para
Pd/C	palladium on carbon
iPr	isopropyl
nPr	n-propyl
R _f	retention factor (TLC)
tert	tertiary
TFA	trifluoroacetic acid
THF	tetrahydrofuran

TLC	thin layer chromatography
TOTU	O-((ethoxycarbonyl)cyanomethyleneamino)-N,N,N',N'-tetramethyluronium-tetrafluoroborat

Further compounds of the formula I can be prepared correspondingly or by known processes.

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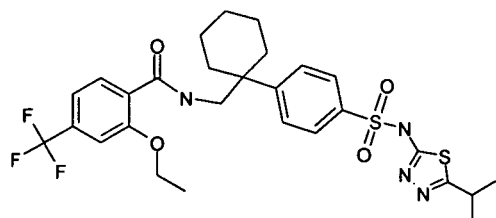
The experimental procedures for preparing the examples mentioned above are described below:

The following examples were prepared according to process A:

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Example 1

2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-yl)sulfamoyl]-phenyl]-cyclohexylmethyl}-4-trifluoromethyl-benzamide



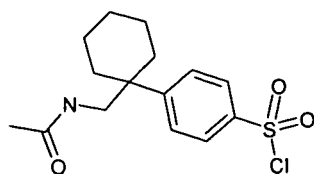
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1a) N-(1-Phenyl-cyclohexylmethyl)-acetamide

was prepared from 1-phenyl-cyclohexyl-methylamine by reaction with acetic anhydride in ethyl acetate as solvent and in the presence of triethylamine.

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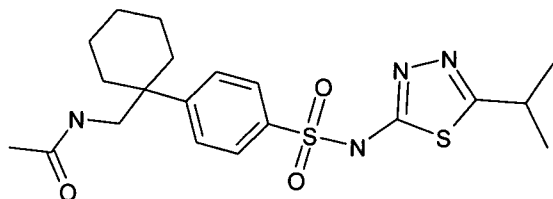
1b) 4-[1-(Acetylamino-methyl)-cyclohexyl]-benzenesulfonyl chloride



4,5 g of N-(1-Phenyl-cyclohexylmethyl)-acetamide were dissolved in 80ml of methylenchloride and 3,8 ml of chlorosulfonic acid were added. The reaction mixture was stirred at 50°C for 10 hours and was poured on ice water. The organic layer was separated, washed twice with 50 ml brine and then dried over MgSO₄. The solvent was removed in vacuo to obtain 1,5 g of a light yellow oil.

MS(ESI): 330 (M+H⁺).

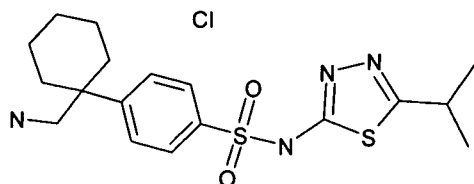
1c) N-{1-[4-(5-Isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclohexylmethyl}-acetamide



600 mg of 5-isopropyl-(1,3,4-thiadiazol-2-ylamine were dissolved in 2 ml of pyridine. 1400 mg of 4-[1-(acetyl-amino-methyl)-cyclohexyl]-benzenesulfonyl chloride were added and the reaction mixture was stirred at room temperature for 15 hours. The pyridine was removed in vacuo and the residue coevaporated three times with portions of 100 ml toluene. The residue was purified by chromatography on silica gel with the eluents dichloromethane : methanol = 95 : 5 to obtain 1,0 g of a light yellow oil.

MS(ESI): 437 (M+H⁺)

1d) 4-(1-Aminomethyl-cyclohexyl)-N-(5-isopropyl-[1,3,4]thiadiazol-2-yl)-benzenesulfonamide hydrochloride



1 g of N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclohexylmethyl}-acetamide was suspended in 25 ml five molar hydrochloric acid and heated under reflux for 20 hours. The cooled reaction mixture was evaporated in vacuo. The residue

was purified by chromatography on silica gel with the eluents dichloromethane : methanol = 95 : 5 to obtain 0,78 g of a with solid.

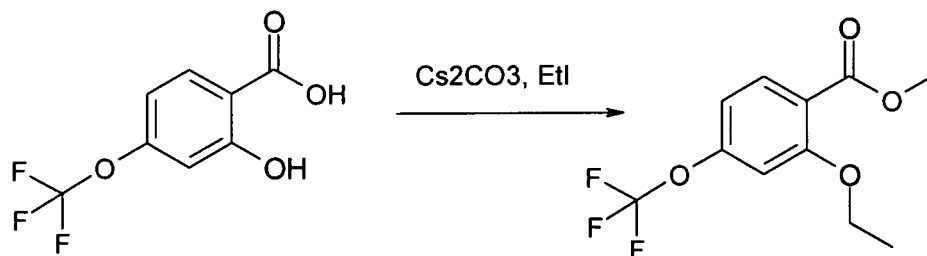
MS(ESI): 395 (M+H+)

5 1e) 2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-yl)sulfamoyl]-phenyl}-cyclohexylmethyl}-4-trifluoromethyl-benzamide

55 mg of 2-ethoxy-4-trifluoromethyl-benzoic acid (example 1g), 85 mg Totu and 100 mg N,N-diisopropylethylamine were dissolved in cold dimethylformamide. After 30 minutes 100 mg of 4-(1-aminomethyl-cyclohexyl)-N-(5-isopropyl-[1,3,4]thiadiazol-2-yl)-benzenesulfonamide hydrochloride were added and the mixture stirred over night. After evaporation of the solvent the residue was purified by chromatography on silica gel with the eluents dichloromethane : methanol = 98 : 2 to obtain 134 mg of an oily product.

15 MS(ESI): 597 (M+H+)

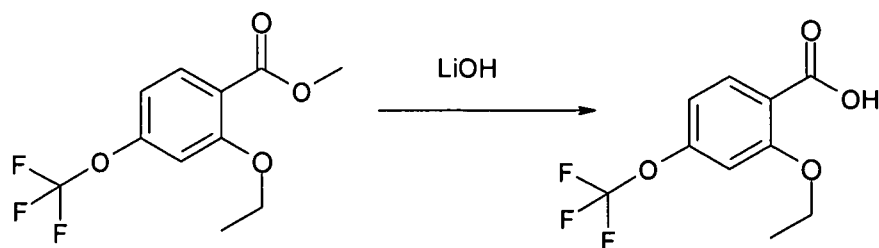
1f) 2-Ethoxy-4-trifluoromethoxy-benzoic acid methyl ester



1.0 g 2-hydroxy-(trifluoromethoxy)benzoic acid were dissolved in 30 ml dimethylformamide. 640 mg iodoethane and 4.70 g cesium carbonate were added and the reaction mixture was stirred at room temperature for three hours. The reaction mixture was diluted by addition of 100 ml ethyl acetate, washed with 30 ml water and brine and then dried over MgSO_4 . The solvent was removed in vacuo to obtain 590 mg 2-ethoxy-4-trifluoromethoxy-benzoic acid methyl ester.

25 MS: (M+1) = 265

1g) 2-Ethoxy-4-trifluoromethoxy-benzoic acid

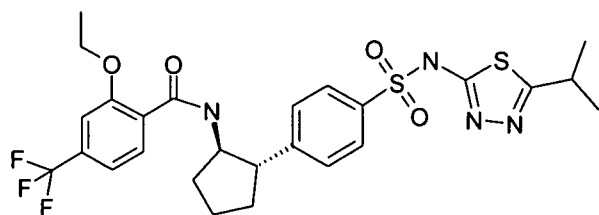


590 mg 2-Ethoxy-4-trifluoromethoxy-benzoic acid methyl ester was dissolved in a mixture of 30 ml tetrahydrofuran and 10 ml water. 367 mg lithium hydroxide were added and the reaction mixture stirred at 60°C for two hours. The cooled reaction mixture was acidified by dropwise addition of concentrated hydrochloric acid, then the mixture was extracted three times with portions of 80 ml ethyl acetate. The combined organic layers were dried over MgSO₄. The solvent was removed in vacuo to obtain 518 mg 2-ethoxy-4-trifluoromethoxy-benzoic acid.

MS: (M+1) = 251

Example 2

2-Ethoxy-N-{trans-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-yl)sulfamoyl]-phenyl]-cyclopentyl}-4-trifluoromethyl-benzamide

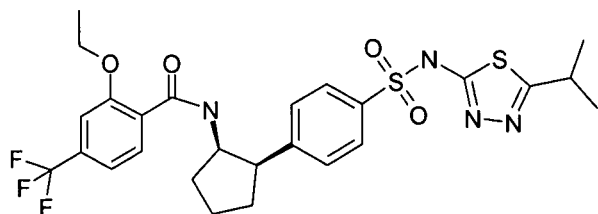


MS(ESI): 583 (M+H⁺)

was prepared by a procedure similar to the preparation described in example 1 starting from trans-2-phenyl-cyclopentylamine

Example 3

2-Ethoxy-N-{cis-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclopentyl}-4-trifluoromethyl-benzamide



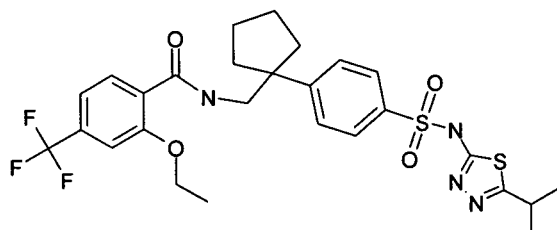
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MS(ESI): 583 (M+H⁺)

was prepared by a procedure similar to the preparation described in example 1 starting from cis-2-phenyl-cyclopentylamine

10 Example 4

2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclopentylmethyl}-4-trifluoromethyl-benzamide



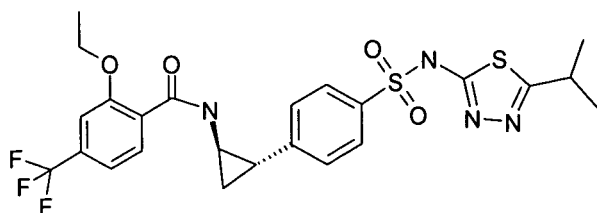
MS(ESI): 597(M+H⁺)

15 was prepared by a procedure similar to the preparation described in example 1 starting from (1-phenyl-cyclopentyl)-methylamine.

Example 5

2-Ethoxy-N-{trans-2-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclopropyl}-4-trifluoromethyl-benzamide

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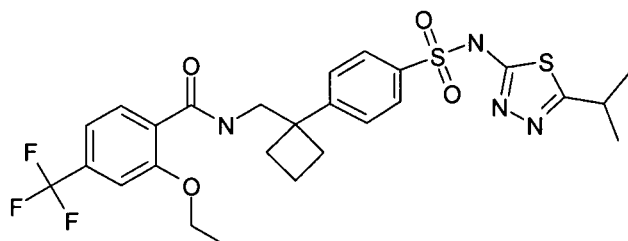


MS(ESI): 555 (M+H⁺)

was prepared by a procedure similar to the preparation described in example 1 starting from trans-2-phenyl-cyclopropylamine.

5 Example 6

2-Ethoxy-N-{1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclobutylmethyl}-4-trifluoromethyl-benzamide

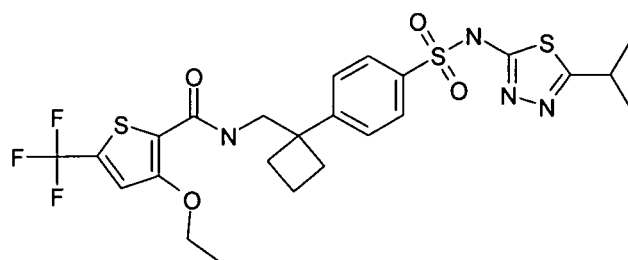


10 MS(ESI): 583 (M+H⁺)

was prepared by a procedure similar to the preparation described in example 1 starting from 1-phenylcyclobutyl-methylamine.

Example 7

15 3-Ethoxy-5-trifluoromethyl-thiophene-2-carboxylic acid {1-[4-(5-isopropyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclobutylmethyl}-amide



MS(ESI): 589 (M+H⁺)

20 was prepared by a procedure similar to the preparation described in example 1 starting from 1-phenylcyclobutyl-methylamine and 3-ethoxy-5-trifluoromethyl-thiophene.

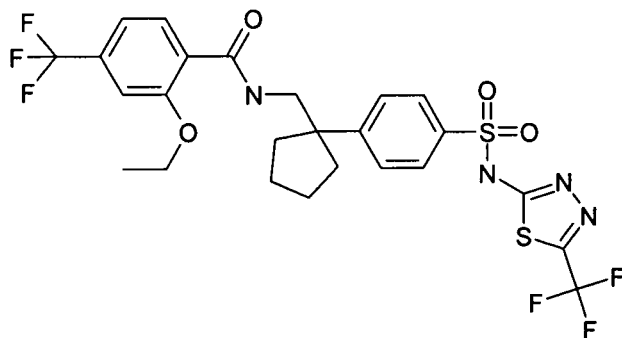
7a) 3-Ethoxy-5-trifluoromethyl-thiophene-2-carboxylic acid (mp.: 143,7°C) was obtained from 3-ethoxy-5-trifluoromethyl-thiophene-2-carboxylic acid methyl ester by hydrolysis with lithium hydroxide in water/methanol.

7b) 3-Ethoxy-5-trifluoromethyl-thiophene-2-carboxylic acid methyl ester (mp.: 93,6°C) was prepared from the known 3-hydroxy-5-trifluoromethyl-thiophene-2-carboxylic acid methyl ester (Synthesis 2000, No.8, 1078-1080) by alkylation with ethyliodide in the presence of cesium carbonate in DMF as solvent.

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Example 8

2-Ethoxy-4-trifluoromethyl-N-{1-[4-(5-trifluoromethyl-[1,3,4]thiadiazol-2-ylsulfamoyl)-phenyl]-cyclopentylmethyl}-benzamide



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MS(ESI): 623 (M+H⁺)

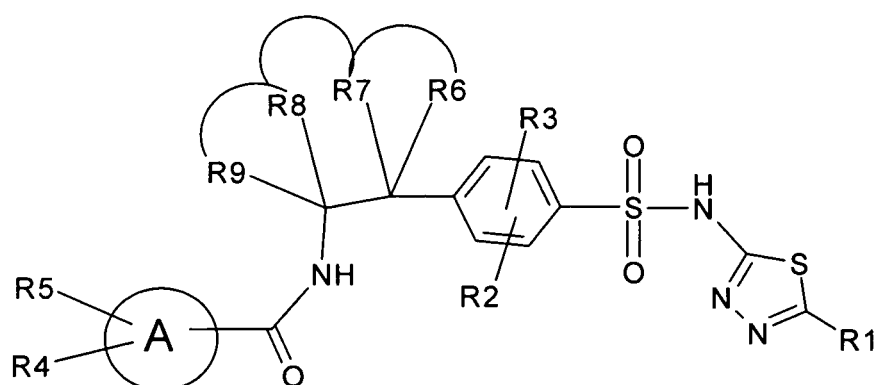
was prepared by a procedure similar to the preparation described in example 1 starting from (1-Phenyl-cyclopentyl)-methylamine and 5-Trifluoromethyl-[1,3,4]thiadiazol-2-ylamine.

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Sanofi-Aventis Deutschland GmbH

Claims

5 1. Compounds of the formula I:



wherein

10 R1 is (C1-C6) alkyl, (C0-C6) alkylene (C3-C6) cycloalkyl, (C0-C6) alkylene-O-(C1-C6) alkyl, (C0-C6) alkylene-O-(C3-C6) cycloalkyl, (C0-C6) alkylene-(C6-C14) aryl, (C0-C6) alkylene-(C5-C15) heteroaryl, wherein alkyl, alkylene, aryl, heteroaryl and cycloalkyl can be unsubstituted or mono, di- or tri substituted
15 by F, Cl, Br, (C1-C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃, CN, CO-(C1-C6) alkyl, COO(C1-C6) alkyl, CON((C0-C6) alkylene-H)((C0-C6) alkylene-H), S(O)_m (C1-C6) alkyl;

20 R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, CN, COO(C1-C6) alkyl, CON((C0-C6)alkylene-H)((C0-C6)alkylene-H), S(O)_m(C1-C6) alkyl, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

25 A is (C6-C14) aryl or (C3-C12) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, CN, CO-(C1-C6) alkyl, COO-(C1-C6) alkyl,

CON((C0-C6) alkylene-H((C0-C6) alkylene-H), S(O)_m(C1-C6) alkyl, N((C0-C6) alkylene-H)((C0-C6) alkylene-H), N((C0-C6) alkylene-H)-CO-(C1-C6) alkyl, N((C0-C6) alkylene-H)-CO-(C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, (C0-C6) alkylene-O-(C6-C14) aryl, SCF₃, S(O)₂CF₃,
5 NO₂, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R₆, R₇, R₈ and R₉ are independently H, (C1-C6) alkyl, (C0-C6) alkylene-(C3-C6) cycloalkyl, (C0-C6) alkylene-(C6-C14) aryl, (C0-C6) alkylene-(C5-C15) heteroaryl, (C0-C6) alkylene-(C3-C15) heterocycloalkyl, (C0-C6) alkylene-(C3-C15) heterocycloalkenyl, wherein alkyl, alkylene and cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, (C1-C6) alkyl, (C0-C6) alkylene-O-(C0-C6)-alkylene-H, CF₃, OCF₃, CN, CO-(C1-C6) alkyl, COO-(C1-C6) alkyl, CON((C0-C6)alkylene-H)((C0-C6)alkylene-H),
10 S(O)_m(C1-C6) alkyl, and wherein aryl, cycloalkyl, heterocycloalkyl, heterocycloalkenyl and heteroaryl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl and (C0-C4) alkylene-O-(C0-C4) alkylene-H

20 and wherein at least one pair of R₆ and R₇, R₈ and R₉, or R₇ and R₈ together with the C-atoms to which they are connected form a (C3-C13) cycloalkyl, a (C3-C9)-heterocycloalkyl or a (C3-C9)-heterocycloalkenyl, wherein cycloalkyl, heterocycloalkyl and heterocycloalkenyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl and (C0-C4) alkylene-O-(C0-C4) alkylene-H;
25

m is 0,1,2;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its
30 physiologically acceptable salts and tautomeric forms.

2. Compounds of the formula I as claimed in claim 1, wherein

R1 is (C1-C6) alkyl, (C0-C6) alkylene (C3-C6) cycloalkyl, (C0-C6) alkylene-O-(C1-C6) alkyl, (C0-C6) alkylene-(C6-C14) aryl, wherein alkyl, alkylene, aryl and
5 cycloalkyl can be unsubstituted or mono, di- or tri substituted by F, Cl, Br, (C1-C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or
10 trisubstituted by F;

A is (C6-C14) aryl or (C3-C12) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, CN, CO-(C1-C6) alkyl, COO-(C1-C6) alkyl,
15 CON((C0-C6) alkylene-H((C0-C6) alkylene-H), halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, SCF₃, S(O)2CF₃, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, (C0-C6) alkylene-(C3-C6) cycloalkyl, (C0-C6) alkylene-(C6-C14) aryl, wherein alkyl, alkylene and
20 cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, (C1-C6) alkyl, (C0-C6) alkylene-O-(C0-C6)-alkylene-H, CF₃, and wherein aryl and cycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl and (C0-C4) alkylene-O-(C0-C4) alkylene-H

25 and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together with the C-atoms to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen, CF₃, (C1-C6) alkyl
30 and (C0-C4) alkylene-O-(C0-C4) alkylene-H;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its

physiologically acceptable salts and tautomeric forms.

3. Compounds of the formula I as claimed in claim 1 or 2, wherein

R1 is (C1-C6) alkyl, (C0-C6) alkylene (C3-C6) cycloalkyl, (C0-C6) alkylene-O-(C1-C6) alkyl, (C0-C6) alkylene-(C6-C14) aryl, wherein alkyl, alkylene, aryl and cycloalkyl can be unsubstituted or mono, di- or tri substituted by F, Cl, Br, (C1-C6) alkyl, O-(C1-C6) alkyl, CF₃, OCF₃;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

A is (C6-C14) aryl, (C5-C6) heteroaryl;

R4, R5 are independently H, (C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, SCF₃, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, unsubstituted or mono, di- or trisubstituted by halogen,

and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together with the C-atoms to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are unsubstituted or mono, di- or trisubstituted by halogen and (C1-C6) alkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

4. Compounds of the formula I as claimed in claim 1, 2 or 3, wherein

R1 is (C1-C6) alkyl, unsubstituted or mono, di- or tri substituted by F;

5 R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

A is (C6-C10) aryl, (C5-C6) heteroaryl;

10 R4, R5 are independently H, (C1-C6) alkyl, halogen, (C0-C6) alkylene-O-(C0-C6) alkylene-H, wherein alkyl and alkylene are unsubstituted or mono, di- or trisubstituted by F;

15 R6, R7, R8 and R9 are independently H, (C1-C6) alkyl, unsubstituted or mono, di- or trisubstituted by halogen,

and wherein at least one pair of R6 and R7, R8 and R9, or R7 and R8 together with the C-atomes to which they are connected form a (C3-C13) cycloalkyl or a (C3-C9)-heterocycloalkyl, wherein cycloalkyl and heterocycloalkyl are
20 unsubstituted or mono, di- or trisubstituted by halogen and (C1-C6) alkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

25 5. Compounds of the formula I as claimed in claims 1 to 4, wherein

R1 is (C1-C6) alkyl, unsubstituted or mono, di- or tri substituted by F;

R2, R3 are independently H, halogen, (C1-C6) alkyl, (C0-C4) alkylene-O-(C0-C4)
30 alkylene-H;

A is phenyl, thiophene;

R4 is O(C1-C4)alkyl and in ortho position;

R5 is CF₃ and in para position;

two of R6, R7, R8 and R9 are H and at least one pair of R6 and R7 or R7 and R8
5 together with the C-atomes to which they are connected form a (C3-C13) cycloalkyl;

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its
physiologically acceptable salts and tautomeric forms.

10

6. Compounds of the formula I as claimed in claims 1 to 5, wherein

R1 is (C1-C6) alkyl, CF₃;

15 R2, R3 are H;

A is phenyl;

R4 is O(C1-C4)alkyl and in ortho position;

20 R5 is CF₃ and in para position;

two of R6, R7, R8 and R9 are H and at least one pair of R6 and R7 or R7 and R8
together with the C-atomes to which they are connected form a (C5-C6)
cycloalkyl;

25

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its
physiologically acceptable salts and tautomeric forms.

7. Compounds of the formula I as claimed in claims 1 to 6, wherein

30 A is phenyl,

R4 is ethoxy and in ortho position

in all its stereoisomeric forms, enantiomeric forms and mixtures in any ratio, and its physiologically acceptable salts and tautomeric forms.

8. A pharmaceutical comprising one or more compounds of the formula I as
5 claimed in one or more of claims 1 to 7.

9. A pharmaceutical comprising one or more compounds of the formula I as
claimed in one or more of claims 1 to 7 and one or more active substances which have
favorable effects on metabolic disturbances or disorders frequently associated
10 therewith.

10. A pharmaceutical comprising one or more compounds of the formula I as
claimed in one or more of claims 1 to 7 and one or more antidiabetics.

11. A pharmaceutical comprising one or more compounds of the formula I as
15 claimed in one or more of claims 1 to 7 and one or more lipid modulators.

12. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use
in the treatment and/or prevention of disorders of fatty acid metabolism and glucose
20 utilization disorders.

13. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use
in the treatment and/or prevention of disorders in which insulin resistance is involved.

14. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use
25 in the treatment and/or prevention of diabetes mellitus including the prevention of the
squellae associated therewith.

15. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use
30 in the treatment and/or prevention of dyslipidemias and their squellae.

16. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use in the treatment and/or prevention of conditions which may be associated with the metabolic syndrome.

5 17. Compounds of the formula I as claimed in one or more of claims 1 to 7 for use in the treatment and/or prevention of demyelinating and other neurodegenerative disorders of the central and peripheral nervous system.

10 18. Compounds as claimed in one or more of claims 1 to 7 in combination with at least one further active compound for use in the treatment of disorders of fatty acid metabolism and glucose utilization disorders.

19. Compounds as claimed in one or more of claims 1 to 7 in combination with at least one further active compound for use in the treatment of disorders in which insulin resistance is involved.

15 20. A process for preparing a pharmaceutical comprising one or more of the compounds as claimed in one or more of claims 1 to 7, which comprises mixing the active compound with a pharmaceutically suitable carrier and bringing this mixture into a form suitable for administration.