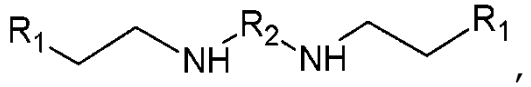
CLAIMS

1. A dicarboxylic acid bisamide derivative of general formula:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

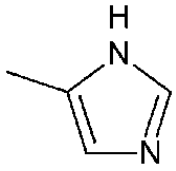
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

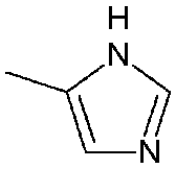
or a pharmaceutically acceptable salt thereof,

with a proviso that the compound is not

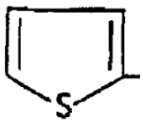
a compound, wherein:

R_1 is  and R_2 is $-C(O)-(CH_2)_3-C(O)-$;

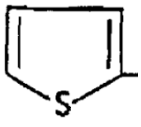
a compound, wherein:

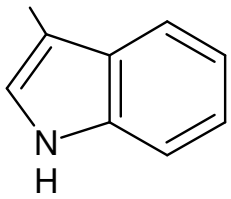
R_1 is  and R_2 is $-C(O)-(CH_2)_4-C(O)-$;

a compound, wherein:

R_1 is  and R_2 is $-C(O)-C(O)-$; or

a compound, wherein:

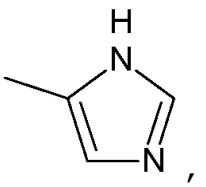
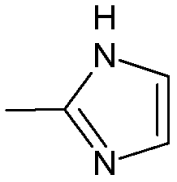
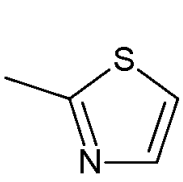
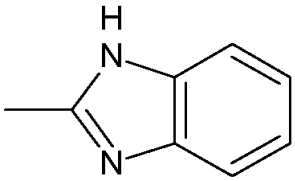
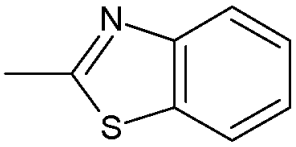
R_1 is  and R_2 is $-C(O)-(CH_2)-C(O)-$,



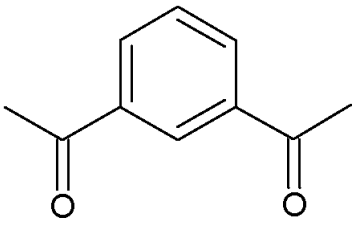
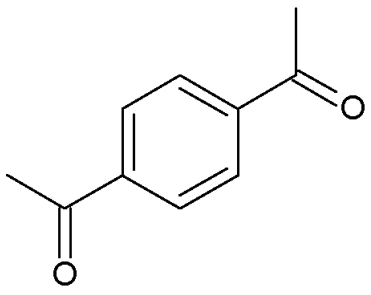
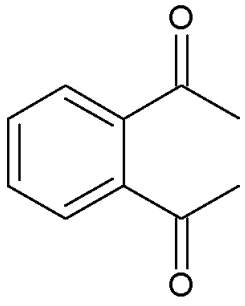
R_1 is and R2 is $-C(O)-(CH_2)n-C(O)-$ wherein n=0, 1, 2, 3 or 4.

2. The compound of claim 1, wherein:

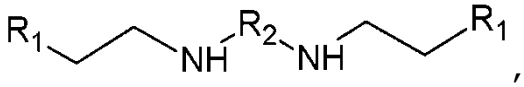
R_1 is a group selected from:

, , , , and ; and

R_2 is a group selected from: $-C(O)-(CH_2)_0-C(O)-$, $-C(O)-(CH_2)_1-C(O)-$, $-C(O)-(CH_2)_2-C(O)-$, $-C(O)-(CH_2)_3-C(O)-$, $-C(O)-(CH_2)_4-C(O)-$, $-C(O)-CH_2-CH(CH_3)-CH_2-C(O)-$, and $-C(O)-CH_2-C(CH_3)_2-CH_2-C(O)-$, or a group selected from

, , and .

3. A compound for use in heavy metal poisoning therapy and in therapy of pathologies associated with iron-excessive conditions and high calcium level conditions due to ability of the compound to chelate with metal ions of Zn, Cu, Fe, Mg, and Ca, wherein the compound is a dicarboxylic acid bisamide derivative of general formula:

,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

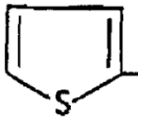
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

with the proviso that the compound is not

a compound wherein R_1 is  and R_2 is $-C(O)-C(O)-$; or

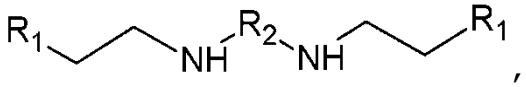
a compound, wherein:

R_1 is  and R_2 is $-C(O)-(CH_2)-C(O)-$,

or a pharmaceutically acceptable salt thereof.

4. A compound of claim 3, wherein said high level calcium conditions include arthroses, atherosclerosis and renal lithiasis .

5. A medicament for use in the prevention and/or treatment of a viral disease, wherein the medicament is a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

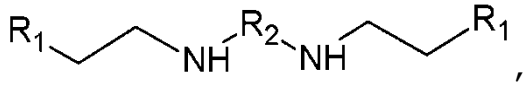
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is -(CH2)n- optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

6. The medicament of claim 5 for use in the prevention and/or treatment of hepatitis C virus, human papilloma virus, HIV, or oncogenic RNA virus, such as leukemia virus.

7. A medicament for use in the prevention and/or treatment of a cardiovascular disease, wherein the medicament is a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

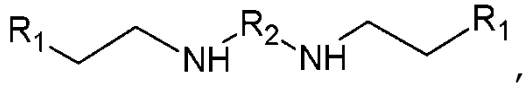
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

8. The medicament of claim 7, for use in the prevention/treatment of disease is caused by cytostatic cardiotoxicity, cholesterol deposition, and hypertension.

9. A medicament for use in prevention and/or treatment of a disease associated with metal-dependent free-radical oxidation reaction due to ability of the medicament antioxidant action, wherein the medicament is a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

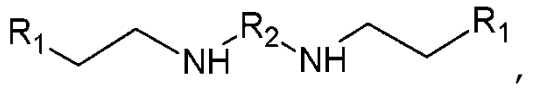
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

10. The medicament of claim 9, for use in prevention and/or treatment of an age-related disease, such as cataract, retinal disease, or skin pigmentation; stroke sequelae; atherosclerosis; or an inflammatory disease, such as osteoarthritis or rheumatoid arthritis.

11. A medicament for use in the prevention and/or treatment of diabetes and its cardiovascular complications, wherein the medicament is a compound of general formula I:



wherein

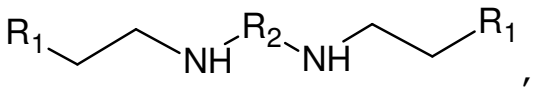
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

12. A medicament for use in the prevention and/or treatment of a neurodegenerative disease, wherein the medicament is a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

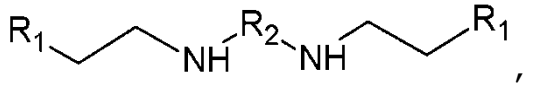
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

13. The medicament of claim 12, wherein the neurodegenerative disease is Alzheimer's disease, Parkinson's disease, Wilson's disease, Huntington's disease, amyotrophic lateral sclerosis, or a prion disease.

14. A medicament for use in the prevention and/or treatment of a cancer disease, wherein the medicament is a compound of general formula I:



wherein

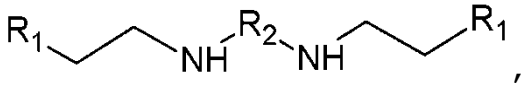
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

15. A medicament for use in the prevention and/or treatment of a disease caused by microbial toxins, wherein the medicament is a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

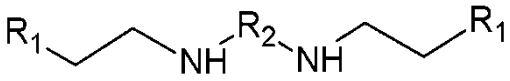
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

16. The medicament of claim 15, for use in the prevention and/or treatment of disease caused by microbial toxins is botulism or gaseous gangrene.

17. A medicament for use in the prevention and/or treatment of alcoholism and alcoholic cirrhosis, wherein the medicament is a compound of general formula I:



wherein

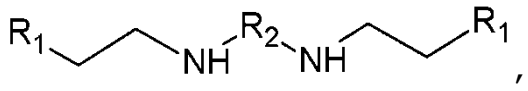
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

18. A medicament for use in the prevention and/or treatment of an iron-excessive anaemia and porphyria cutanea tarda, wherein the medicament is a compound of general formula I:



wherein

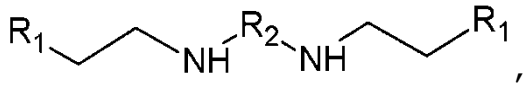
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

19. A medicament for use in the prevention and/or treatment of transition metal salt poisoning, wherein the medicament is a compound of general formula I:



wherein

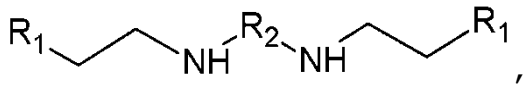
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

20. A pharmaceutical composition for the prevention and/or treatment of a viral disease, comprising an effective amount of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

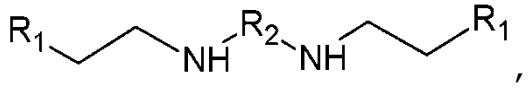
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

21. The pharmaceutical composition of claim 20, wherein the viral disease is caused by hepatitis C virus, human papilloma virus, HIV, or oncogenic RNA virus, such as leukemia virus.

22. A pharmaceutical composition for the prevention and/or treatment of a cardiovascular disease, comprising an effective amount of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

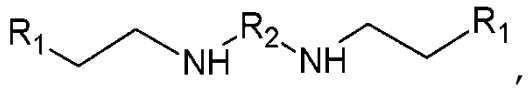
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

23. The pharmaceutical composition of claim 22, wherein the cardiovascular disease is caused by cytostatic cardiotoxicity, cholesterol deposition, or hypertension.

24. A pharmaceutical composition having antioxidant action, comprising an effective amount of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

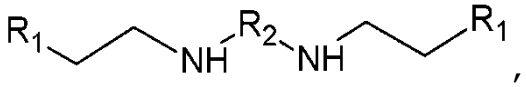
n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

25. The pharmaceutical composition of claim 24 for the prevention and/or treatment of a disease associated with metal-dependent free radical oxidation reaction.

26. The pharmaceutical composition of claim 24 or 25, wherein the disease associated with metal-dependent free-radical oxidation reaction is an age-related disease, such as cataract, retinal disease, or skin pigmentation; stroke sequelae; atherosclerosis; or an inflammatory disease, such as osteoarthritis or rheumatoid arthritis.

27. A pharmaceutical composition for the prevention and/or treatment of diabetes and its cardiovascular complications, comprising an effective amount of a compound of general formula I:



,

wherein

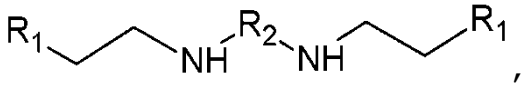
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

28. A pharmaceutical composition for the prevention and/or treatment of a neurodegenerative disease, comprising an effective amount of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

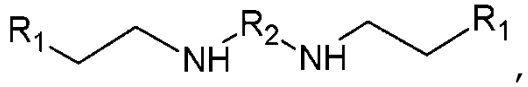
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

29. The pharmaceutical composition of claim 28, wherein the neurodegenerative disease is Alzheimer's disease, Parkinson's disease, Wilson's disease, Huntington's disease, amyotrophic lateral sclerosis, or a prion disease.

30. A pharmaceutical composition for the prevention and/or treatment of a cancer disease, comprising an effective amount of a compound of general formula I:



wherein

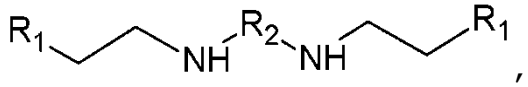
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

31. A pharmaceutical composition for the prevention and/or treatment of a disease caused by microbial toxins, comprising an effective amount of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

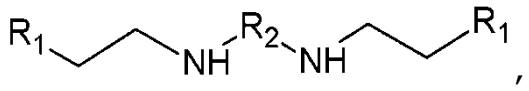
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

32. The pharmaceutical composition of claim 31, wherein the disease caused by microbial toxins is botulism or gaseous gangrene.

33. A pharmaceutical composition for the prevention and/or treatment of alcoholism and alcoholic cirrhosis, comprising an effective amount of a compound of general formula I:



wherein

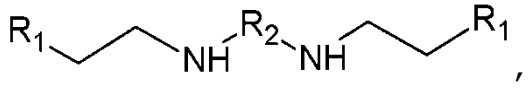
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

34. A pharmaceutical composition for the prevention and/or treatment of iron-excessive anaemia and porphyria cutanea tarda, comprising an effective amount of a compound of general formula I:



wherein

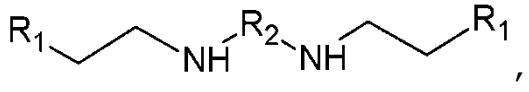
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

35. A pharmaceutical composition for the prevention and/or treatment of transition metal salt poisoning, comprising an effective amount of a compound of general formula I:



wherein

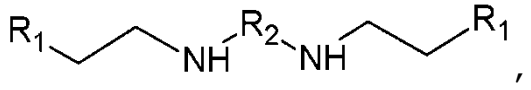
R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof.

36. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

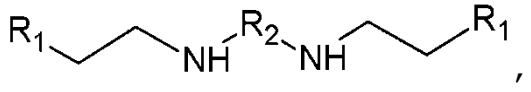
n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of a viral disease.

37. The use of claim 36, wherein the viral disease is caused by hepatitis C virus, human papilloma virus, HIV, or oncogenic RNA virus, such as leukemia virus.

38. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

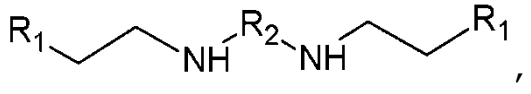
n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of a cardiovascular disease.

39. The use of claim 38, wherein the cardiovascular disease is caused by cytostatic cardiotoxicity, cholesterol deposition, or hypertension.

40. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

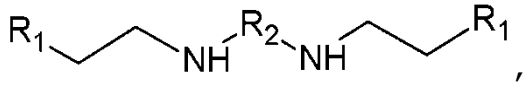
or a pharmaceutically acceptable salt thereof

for the manufacture of a medicament with antioxidant action.

41. The use of claim 40 for the prevention and/or treatment of a disease associated with metal-dependent free-radical oxidation reaction.

42. The use of claim 40 or 41, wherein the disease associated with metal-dependent free-radical oxidation reaction is an age-related disease, such as cataract, retinal disease, or skin pigmentation; stroke sequelae; atherosclerosis; or an inflammatory disease, such as osteoarthritis or rheumatoid arthritis.

43. Use of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

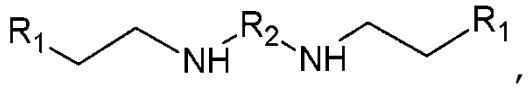
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of diabetes and its cardiovascular complications.

44. Use of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

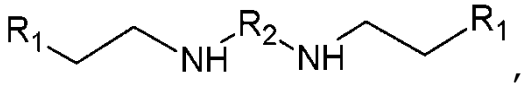
n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of a neurodegenerative disease.

45. The use of claim 44, wherein the neurodegenerative disease is Alzheimer's disease, Parkinson's disease, Wilson's disease, Huntington's disease, amyotrophic lateral sclerosis, or a prion disease.

46. Use of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

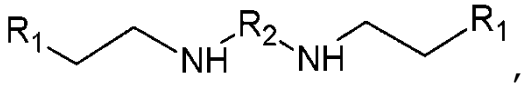
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of a cancer disease.

47. Use of a compound of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

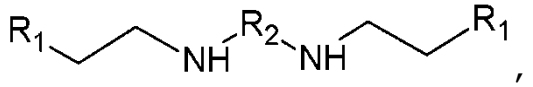
n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of a disease caused by microbial toxins.

48. The use of claim 47, wherein the disease caused by microbial toxins is botulism or gaseous gangrene.

49. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

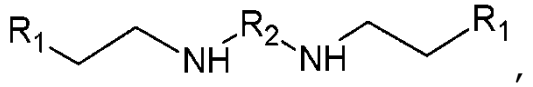
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of alcoholism and alcoholic cirrhosis.

50. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

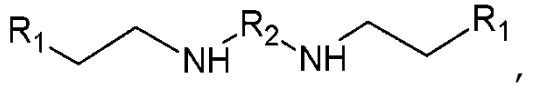
R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of iron-excessive anaemia and porphyria cutanea tarda.

51. Use of a compound of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

or a pharmaceutically acceptable salt thereof

for the prevention and/or treatment of transition metal salt poisoning.

52. A method for producing a compound of claim 1,

comprising condensing a dicarboxylic acid of general formula II:

$$R_4O-C(O)-R_3-C(O)-OR_4,$$

wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl,

n is an integer from 0 to 4, and

R_4 is hydrogen or C_1-C_6alkyl,

with an amine of general formula III:

$$NH_2-(CH_2)_2-R_1,$$

wherein R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group

under heating, and optionally in the presence of a solvent.

53. The method of claim 52, wherein the solvent is selected from a dicarboxylic acid dimethyl or diethyl ether and the step of heating is conducted at a temperature of between 150 and 170°C.

54. The method of claim 52, wherein the step of condensing is conducted in an isoamyl alcohol solution under boiling.

55. A method for manufacturing a compound of claim 1

comprising contacting a dicarboxylic acid of general formula II:

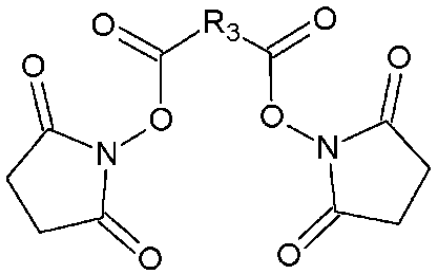
$$R_4O-C(O)-R_3-C(O)-OR_4,$$

wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl, or phenyl,

n is an integer from 0 to 4, and

R_4 is hydrogen,

with N-hydroxysuccinimide in the presence of N,N'-dicyclohexylcarbodiimide to form a corresponding bis-N-oxysuccinimide ester of general formula IV:



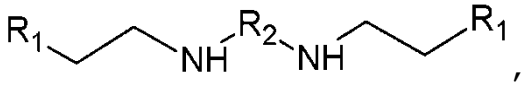
that is condensed with an amine of general formula III:

$$NH_2-(CH_2)_2-R_1,$$

wherein R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group.

56. The method of claim 55, wherein the step of condensing is conducted at a temperature of 0 to 5°C.

57. A method for producing a dicarboxylic acid bisamide derivative of general formula I:



wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

comprising contacting a dicarboxylic acid of general comprising contacting a dicarboxylic acid of general formula II:

$$R_4O-C(O)-R_3-C(O)-OR_4,$$

wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl,

n is an integer from 0 to 4,

R_4 is C_1-_6alkyl,

with hydrazine hydrate in an organic solvent to form bishydrazide of general formula V:

$$H_2N-NH-C(O)-R_3-C(O)-NH-NH_2,$$

treating the bishydrazide with sodium nitrite in an acidic medium at a temperature of about 0°C to form bisazide of general formula VI:

$$N^-=N^+=N-C(O)-R_3-C(O)-N=N^+=N^-,$$

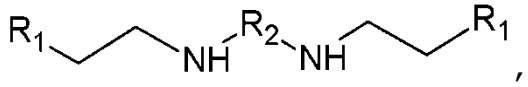
condensing the azide with an amine of general formula III:

$$NH_2-(CH_2)_2-R_1,$$

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group in an organic solvent.

58. The method of claim 57, wherein the organic solvent is an alcohol, preferably isopropanol.

59. A method for producing a dicarboxylic acid bisamide derivative of general formula I:



,

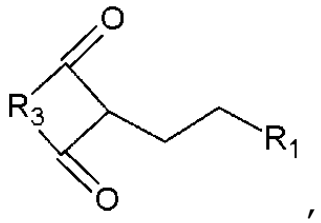
wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

comprising condensing an imide of general formula VII:



,

wherein R_3 is $-(CH_2)_n-$ optionally substituted with one or two C_1-C_6alkyl groups, n is an integer from 0 to 4,

with an equimolar amount of an amine of general formula III:

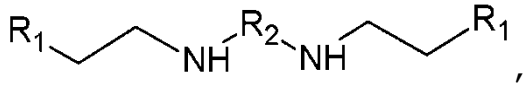
$NH_2-(CH_2)_2-R_1$,

wherein R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group

in an organic solvent under heating.

60. The method of claim 59, wherein the organic solvent is an alcohol, preferably isopropanol, and the step of condensing is conducted under boiling.

61. A method for producing a dicarboxylic acid bisamide derivative of general formula I:



,

wherein

R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group;

R_2 is $-C(O)-R_3-C(O)-$, wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl; and

n is an integer from 0 to 4;

comprising contacting a dicarboxylic acid of general formula II:

$R_4O-C(O)-R_3-C(O)-OR_4$,

wherein R_3 is $-(CH_2)_n-$ optionally substituted with one to two C_1-C_6alkyl groups or phenyl,

n is an integer from 0 to 4, and

R_4 is hydrogen,

with an amine of general formula III:

$NH_2-(CH_2)_2-R_1$,

wherein R_1 is a 5-membered unsaturated heterocyclic group comprising from 1 to 2 heteroatoms selected from N and/or S, optionally condensed with a 6-membered unsaturated cyclic group

in a molar ratio of 1:2-2.5 in a tetrahydrofuran solution in the presence of a condensing agent.

62. The method of claim 61, wherein the condensing agent is carbonyldiimidazole.