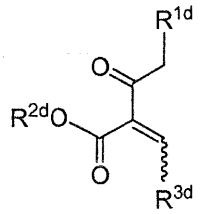
(wherein R^a is hydrogen, hydroxy, lower alkylamino optionally substituted by substituent E, lower alkenylamino optionally substituted by substituent E, lower alkynylamino optionally substituted by substituent E, carbocyclyl lower alkylamino optionally substituted by substituent E, or heterocyclyl lower alkylamino optionally substituted by substituent E, and

each symbol is as defined ~~above~~ in claim 1)

comprising the step of:

reacting a compound shown by formula (X2):

[Chemical formula 6]

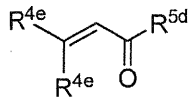


(X2)

(wherein each symbol is defined above)

with a compound shown by formula (VA2):

[Chemical formula 7]



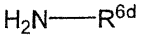
(VA2)

(wherein R^{4e}s are each independently hydrogen, lower alkyl optionally substituted by substituent E, carbocyclyl optionally substituted by substituent E, or heterocyclyl optionally substituted by substituent E, and

R^{5d} and substituent E are defined above); and

reacting with a compound shown by formula (V3):

[Chemical formula 8]

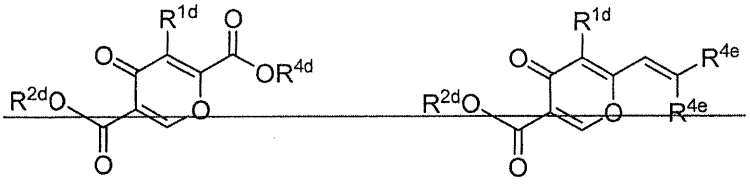


(V3)

(wherein R^{6d} is defined above).

~~4. A method of producing a compound shown by formula (X3) or formula (XA3), or a salt thereof:~~

~~[Chemical formula 12]~~

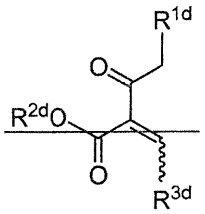


(X3) (XA3)

~~(wherein each symbol is defined in claim 1)~~

~~comprising reacting a compound shown by formula (X2):~~

~~[Chemical formula 10]~~

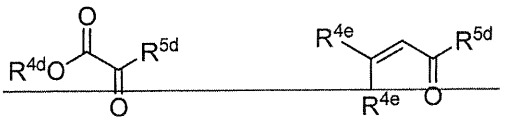


(X2)

~~(wherein each symbol is defined in claim 1)~~

~~with a compound shown by formula (V2) or formula (VA2):~~

~~[Chemical formula 11]~~

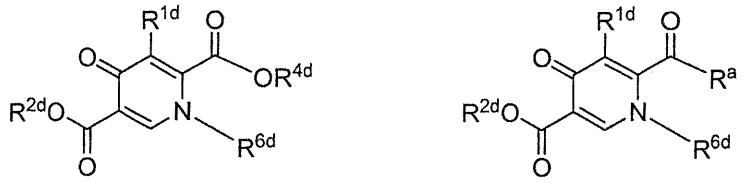


(V2) (VA2)

~~(wherein each symbol is defined in claim 1).~~

~~5~~4. A method of producing a compound shown by formula (X4) or formula (XA4), or a salt thereof:

[Chemical formula 15]



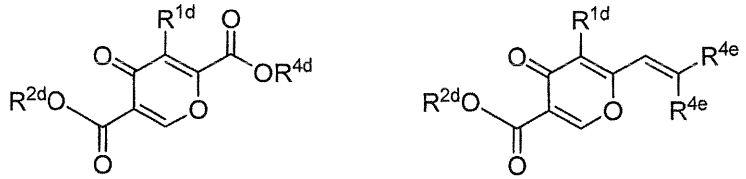
(X4) (XA4)

(wherein each symbol is defined in claim 1 or claim 3)

comprising the step of:

reacting a compound shown by formula (X3) or formula (XA3):

[Chemical formula 13]

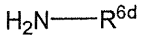


(X3) (XA3)

(wherein each symbol apart from R^{4e} is defined in claim 1 and R^{4e} is defined in claim 3)

or the derivative of formula (XA3) with a compound shown by formula (V3):

[Chemical formula 14]

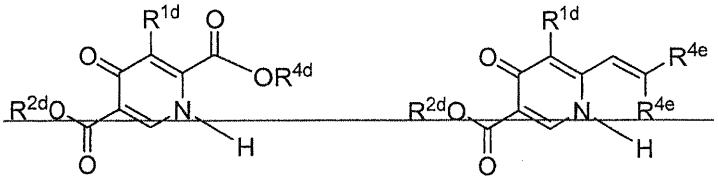


(V3)

(wherein each symbol is defined in claim 1).

~~6. A method of producing a compound shown by formula (X4') or formula (XA4'), or a salt thereof:~~

~~[Chemical formula 19]~~

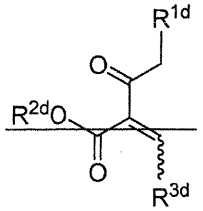


(X4') (XA4')

~~(wherein each symbol is defined in claim 1)~~

~~comprising reacting a compound shown by formula (X2):~~

~~[Chemical formula 16]~~

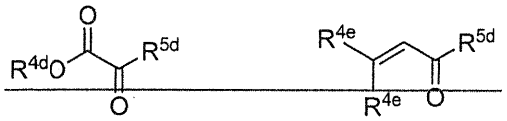


(X2)

~~(wherein each symbol is defined in claim 1)~~

~~with a compound shown by formula (V2) or formula (VA2):~~

~~[Chemical formula 17]~~



(V2) (VA2)

~~(wherein each symbol is defined in claim 1)~~

~~and a compound shown by formula (V2'):~~

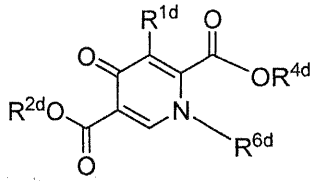
~~[Chemical formula 1]~~

~~NH^{4+} X^{d-} (V2')~~

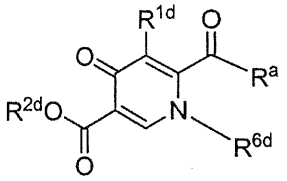
~~(wherein X^{d-} is counter anion of ammonium cation).~~

~~7~~5. A method of producing a compound shown by formula (X4) or formula (XA4), or a salt thereof:

[Chemical formula 22]



(X4)



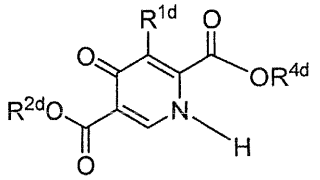
(XA4)

(wherein each symbol is defined in claim 1 or claim 3)

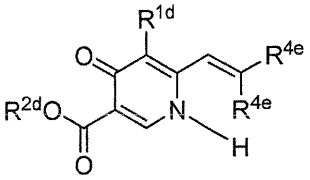
comprising the step of:

reacting the compound shown by formula (X4') or formula (XA4'):

[Chemical formula 20]



(X4')



(XA4')

(wherein each symbol apart from R^{4e} is defined in claim 1 and R^{4e} is defined in claim 3)

obtained in the production method as defined in claim 6, or the derivative of formula (XA4') with a compound shown by formula (V3'):

[Chemical formula 21]

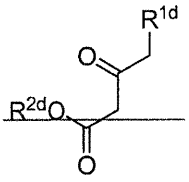
R^{6d}——L^{d} (V3')

(wherein R^{6d} is defined in claim 1,

L^d is a leaving group, and Ph is a phenyl group).

~~8. A method according to claim 1, 2, 3, 4 or 6, wherein the compound shown by formula (X2) is obtained by reacting a compound shown by formula (X1):~~

~~[Chemical formula 23]~~

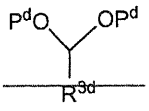


(X1)

~~(wherein each symbol is defined in claim 1)~~

~~with a compound shown by formula (V1):~~

~~[Chemical formula 24]~~

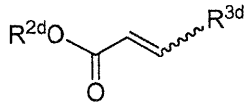


(V1)

~~(wherein P^d is lower alkyl optionally substituted by substituent E, and R^{3d} and substituent E are defined in claim 1).~~

~~9~~6. A method according to claim 1, 2, or 3, ~~4 or 6~~, wherein the compound shown by formula (X2) is obtained by reacting a compound shown by formula (Z1):

[Chemical formula 25]

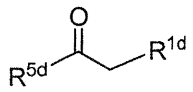


(Z1)

(wherein each symbol is defined in claim 1)

with a compound shown by formula (Z2):

[Chemical formula 26]

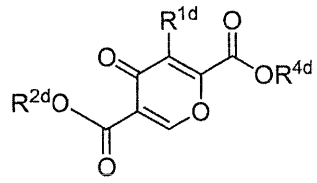


(Z2)

(wherein each symbol is defined in claim 1).

~~10~~7. A compound shown by formula (X3), or a pharmaceutically acceptable salt thereof or solvate thereof:

[Chemical formula 27]

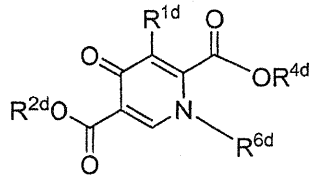


(X3)

(wherein each symbol is defined in claim 1).

~~11~~8. A compound shown by formula (X4), or a pharmaceutically acceptable salt thereof or solvate thereof:

[Chemical formula 28]

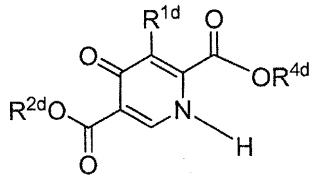


(X4)

(wherein each symbol is defined in claim 1).

~~12~~9. A compound shown by formula (X4'), or a pharmaceutically acceptable salt thereof or solvate thereof:

[Chemical formula 29]

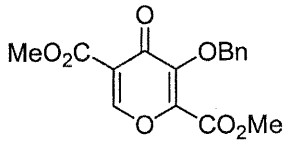


(X4')

(wherein each symbol is defined in claim 1).

~~13~~10. A crystal of a compound shown by formuala (1D) or a solovate thereof:

[Chemical formula 30]



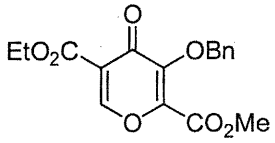
(1D)

(wherein Me is a methyl group, and Bn is a benzyl group),

wherein the compound has a peak at a diffraction angle (2θ): 7.9° ± 0.2°, 10.0° ± 0.2°, 11.5° ± 0.2°, 20.0° ± 0.2°, 23.4° ± 0.2° and 34.0° ± 0.2° in a powder X-ray diffraction spectrum.

~~14~~11. A crystal of a compound reprsented by formula (2D) or a solvate thereof:

[Chemical formula 31]



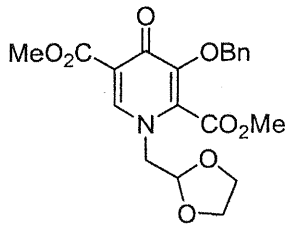
(2D)

(wherein Me is a methyl group, Et is an ethyl group, and Bn is a benzyl group),

wherein the compound has a peak at a diffraction angle (2θ): 17.6° ± 0.2°, 25.2° ± 0.2°, 26.4° ± 0.2° and 28.1° ± 0.2° in a powder X-ray diffraction spectrum.

~~15~~12. A crystal of a compound shown by formula (9C') or a solvate thereof:

[Chemical formula 32]



(9C')

(wherein Me is a methyl group, and Bn is a benzyl group),

wherein the compound has a peak at a diffraction angle (2θ): 14.2° ± 0.2°, 16.0° ± 0.2°, 22.0° ± 0.2°, 22.2° ± 0.2°, 24.4° ± 0.2° and 25.9° ± 0.2° in a powder X-ray diffraction spectrum.

~~16~~13. A crystal according to claim ~~13~~10, which is charactrized by a powder X-ray diffraction spectrum which is substantially consistent with Fig. 1.

~~17~~14. A crystal according to claim ~~14~~11, which is charactrized by a powder X-ray diffraction spectrum which is substantially consistent with Fig. 2.

~~18~~15. A crystal according to claim ~~15~~12, which is charactrized by a powder X-ray diffraction spectrum which is substantially consistent with Fig. 3.