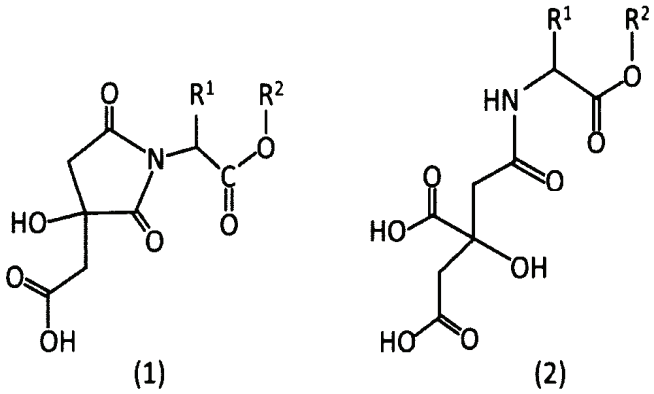
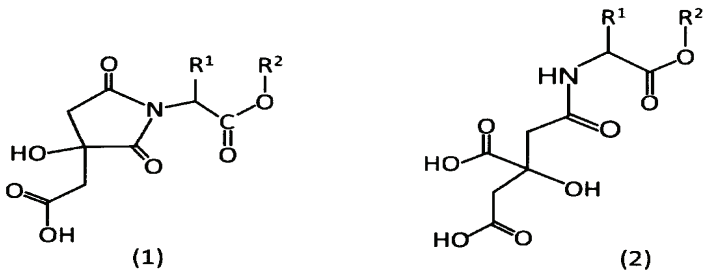
(wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain).

[12] A food additive comprising one or more compounds represented by formulas (1) and (2):



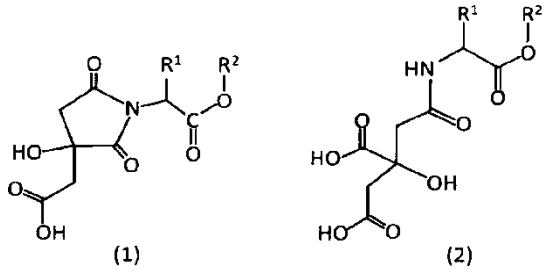
(wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain).

[0009a] In one aspect, there is provided a compound represented by formula (1) or (2):



wherein R^1 represents a methyl group substituted with a carboxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

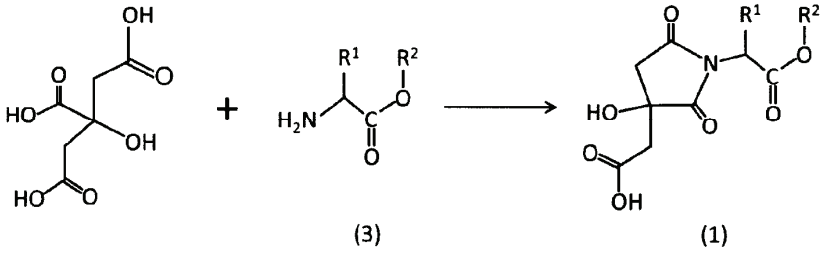
In another aspect, there is provided the use of one or more purified compounds represented by formulas (1) and (2):



wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain, for the manufacture of a medicament for the cure or prevention of a liver disorder selected from the group consisting of acute hepatitis, chronic hepatitis, fatty liver, hepatitis A, hepatitis B, hepatitis C, cholestatic liver disorder, liver failure, alcoholic liver disorder, nonalcoholic steatohepatitis (NASH), drug-induced liver disorder, and autoimmune liver disorder.

In another aspect, there is provided a method for synthesizing a compound represented by formula (1), comprising reacting by heating a mixture of citric acid

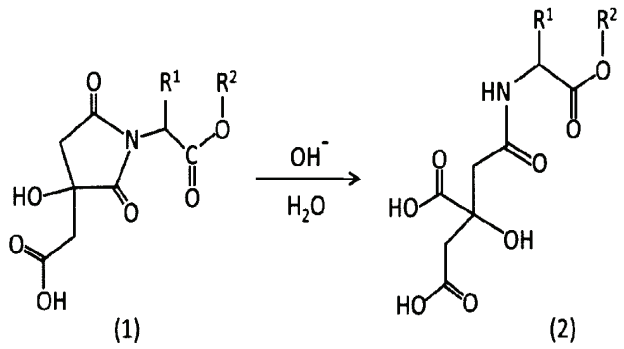
and an amine compound represented by formula (3) in an aqueous solution:



(3) (1)

wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

In another aspect, there is provided a method for conversion to a compound of formula (2), comprising heating a compound represented by formula (1) in an aqueous solution to which an alkaline substance for generating hydroxide ions is added:

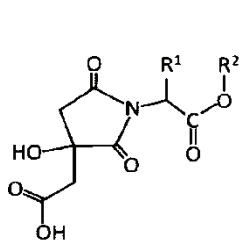


(1) (2)

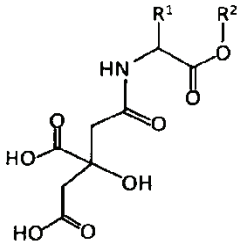
wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group, and R^2 represents a hydrogen atom,

or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

In another aspect, there is provided the use of one or more purified compounds represented by formulas (1) and (2):



(1)



(2)

wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain, for the manufacture of a food product.

Effect of the Invention

[0010]

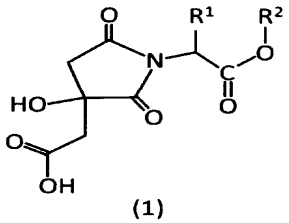
The compounds represented by formulas (1) and (2) have an inhibitory effect against liver disorder. Further, compounds I and V can be extracted, derived, and isolated also from ume extract.

Brief Description of Drawings

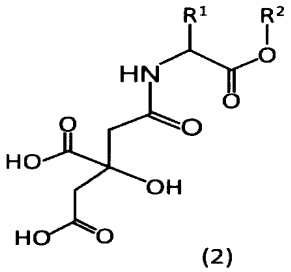
[0011]

CLAIMS

1. A compound represented by formula (1) or (2):



(1)

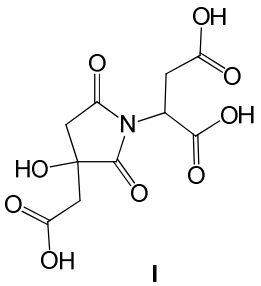


(2)

wherein R^1 represents a methyl group substituted with a carboxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

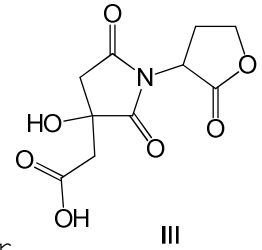
2. The compound according to claim 1, wherein

the compound represented by formula (1) is represented by the following structures:



I

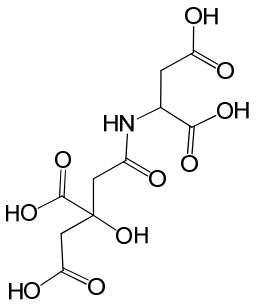
, or



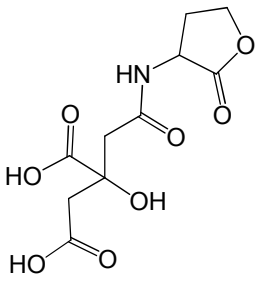
III .

3. The compound according to claim 1, wherein

the compound represented by formula (2) is represented by the following structures:

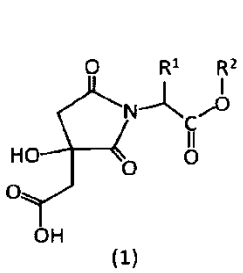


V , or

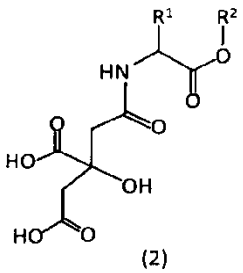


VII .

4. The use of one or more purified compounds represented by formulas (1) and (2):



(1)



(2)

wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain,

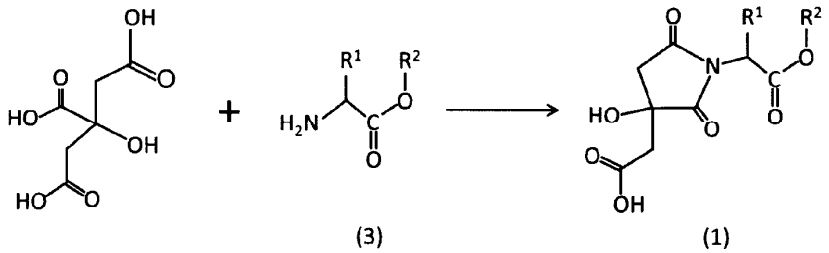
for the manufacture of a medicament for the cure or prevention of a liver disorder selected from the group consisting of acute hepatitis, chronic hepatitis, fatty liver, hepatitis A, hepatitis B, hepatitis C, cholestatic liver disorder, liver failure, alcoholic liver disorder, nonalcoholic steatohepatitis (NASH), drug-induced liver disorder, and autoimmune liver disorder.

5. The use according to claim 4, wherein the liver disorder is nonalcoholic steatohepatitis (NASH).

6. The use according to claim 4 or 5, wherein R^1 represents a methyl group substituted with a carboxyl group, and R^2 represents a hydrogen atom.

7. A method for synthesizing a compound represented by formula (1), comprising:

reacting by heating a mixture of citric acid and an amine compound represented by formula (3) in an aqueous solution:



(3) (1)

wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

8. The method according to claim 7, wherein R^1 represents a methyl group substituted with a carboxyl group, and R^2 represents a hydrogen atom.

9. The method according to claim 7, wherein

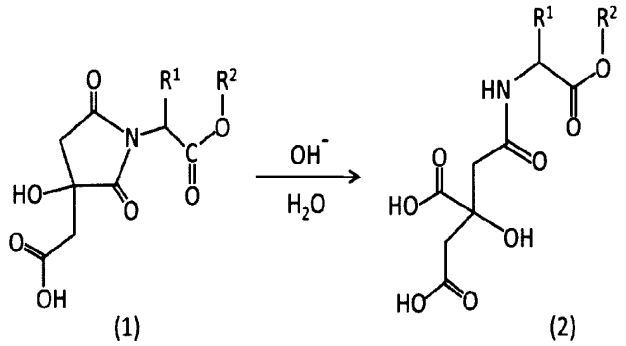
the mixture of the citric acid and the amine compound represented by formula (3) is reacted at 100 to 130°C for 30 minutes to 300 minutes.

10. The method according to any one of claims 7 to 9, wherein

a mixing ratio of the citric acid to the amine compound represented by formula (3) (concentration of the citric acid:concentration of the amine compound represented by formula (3)) is 75:1 to 12:10.

11. A method for conversion to a compound of formula (2), comprising:

heating a compound represented by formula (1) in an aqueous solution to which an alkaline substance for generating hydroxide ions is added:

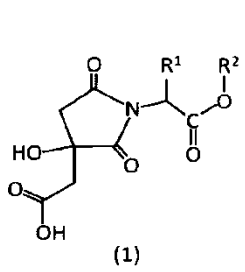


wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain.

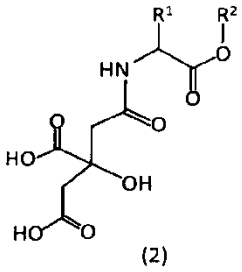
12. The method according to claim 11, wherein R^1 represents a methyl group having a carboxyl group, and R^2 represents a hydrogen atom.

13. The method according to claim 11 or 12, wherein the compound represented by formula (1) is allowed to react in an aqueous solution having a pH of 6.0 to 12.0 to which the alkaline substance for generating hydroxide ions is added, at 80 to 130°C for 20 minutes to 240 minutes.

14. The use of one or more purified compounds represented by formulas (1) and (2):



(1)



(2)

wherein R^1 represents a C1 to C3 alkyl group optionally having a carboxyl group or a hydroxyl group, and R^2 represents a hydrogen atom, or R^1 and R^2 optionally form a cyclic structure together to represent a C2 to C3 alkylene chain,
for the manufacture of a food product.

15. The use according to claim 14, wherein R^1 represents a methyl group substituted with a carboxyl group, and R^2 represents a hydrogen atom.