heme protein of the present invention is characterized by bringing disulfonic acid or a salt thereof into coexistence in a sample containing the heme protein.

[0012]

In one aspect, the present disclosure refers to a method for stabilizing a heme protein, wherein a disulfonic acid or a salt thereof is brought into coexistence in a sample comprising a heme protein, the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and the disulfonic acid or a salt thereof is at least one selected from the group consisting of: a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms; and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

In another aspect, the present disclosure refers to an immunoassay method for a heme protein, comprising a step of bringing a heme protein into contact with an antiheme protein antibody in the presence of a disulfonic acid or a salt thereof, wherein the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and the disulfonic acid or a salt thereof is at least one selected from the group consisting of: a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms; and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

In yet another aspect, the present disclosure refers to a preservative solution for a heme protein, comprising a disulfonic acid or a salt thereof, wherein the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon

group, and the disulfonic acid or a salt thereof is at least one selected from the group consisting of: a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms; and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

Specifically, the present disclosure encompasses the following (1) to (10).

[0013]

(1) A preservative solution for a heme protein, containing a disulfonic acid or a salt thereof.

[0014]

(2) The preservative solution for a heme protein according to (1), wherein

the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and

the disulfonic acid or a salt thereof is at least one selected from the group consisting of:

a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms;

a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms; and

a disulfonic acid or a salt thereof in which the cycloalkylene group or the aryl group has one or more substituted nitrogen atoms.

[0015]

(3) The preservative solution for a heme protein according to (1) or (2), wherein the disulfonic acid or a salt thereof is at least one selected from the group consisting of methanedisulfonic acid, ethanedisulfonic acid, propanedisulfonic acid, butanedisulfonic acid, naphthalenedisulfonic acid, and piperazine-N,N'-bis(2-ethanesulfonic acid) or a salt thereof.

[0016]

(4) The preservative solution for a heme protein according to any one of (1) to (3), wherein the concentration of the disulfonic acid or a salt thereof is 0.001 mol/L or more and 0.3 mol/L or less.

[0017]

Claims

1. A method for stabilizing a heme protein, wherein a disulfonic acid or a salt thereof is brought into coexistence in a sample comprising a heme protein,

the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and

the disulfonic acid or a salt thereof is at least one selected from the group consisting of:

a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and

a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms;

and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

2. The method of claim 1, wherein the disulfonic acid consists of an open chain or cyclic hydrocarbon group and two sulfone groups.

3. The method of claim 1, wherein the disulfonic acid has a substituent and the substituent is a halogen group and/or a hydroxy group.

4. The method of claim 1, wherein the disulfonic acid or a salt thereof is at least one selected from the group consisting of methanedisulfonic acid, ethanedisulfonic acid, propanedisulfonic acid, butanedisulfonic acid and naphthalenedisulfonic acid or a salt thereof.

5. The method of any one of claims 1 to 4, wherein N-(2-hydroxyethyl)piperazine-N'-ethanesulfonic acid is further brought into coexistence in a sample comprising said heme protein.

6. The method of any one of claims 1 to 5, wherein the concentration of the disulfonic acid or a salt thereof is 0.001 mol/L or more and 0.3 mol/L or less.

7. An immunoassay method for a heme protein, comprising a step of bringing a heme protein into contact with an antiheme protein antibody in the presence of a disulfonic acid or a salt thereof,

wherein the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and

the disulfonic acid or a salt thereof is at least one selected from the group consisting of:

a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and
a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms;
and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

8. A preservative solution for a heme protein, comprising a disulfonic acid or a salt thereof,
wherein the disulfonic acid or a salt thereof has at least one of an open chain hydrocarbon group and a cyclic hydrocarbon group, and
the disulfonic acid or a salt thereof is at least one selected from the group consisting of:

a disulfonic acid or a salt thereof in which the open chain hydrocarbon group is a branched or linear hydrocarbon group and the main chain of the branched open chain hydrocarbon group or the linear open chain hydrocarbon group has any one of 1 to 10 carbon atoms; and
a disulfonic acid or a salt thereof in which the cyclic hydrocarbon group is a cycloalkylene group or an aryl group and the cyclic hydrocarbon group has any one of 3 to 10 carbon atoms;
and wherein the heme protein is hemoglobin, myoglobin, peroxidase, or catalase.

9. The preservative solution of claim 8, wherein the disulfonic acid consists of an open chain or cyclic hydrocarbon group and two sulfone groups.

10. The preservative solution of claim 8, wherein the disulfonic acid has a substituent and the substituent is a halogen group and/or a hydroxy group.

11. The preservative solution of claim 8, wherein the disulfonic acid or a salt thereof is at least one selected from the group consisting of methanedisulfonic acid, ethanedisulfonic acid, propanedisulfonic acid, butanedisulfonic acid, and naphthalenedisulfonic acid or a salt thereof.

12. The preservative solution of any one of claims 8 to 11, wherein the concentration of the disulfonic acid or a salt thereof is 0.001 mol/L or more and 0.3 mol/L or less.

13. The preservative solution of any one of claims 8 to 12, further comprising N-(2-hydroxyethyl)piperazine-N'-ethanesulfonic acid.

14. The preservative solution of any one of claims 8 to 13, further comprising a heme protein used as a reference sample or a control sample.

15. The preservative solution of any one of claims 8 to 14, which is used for immunoassay.