CLAIMS

1. A method for determining the undifferentiated state of pluripotent stem cells, comprising the steps of:

irradiating a test culture medium in which pluripotent stem cells are cultured with wavelength light having a wavelength in the range of 190 nm to 2,500 nm or a partial range thereof, and detecting the reflected light, transmitted light or transmitted reflected light thereof to obtain absorbance spectrum data; and

analyzing the absorbance at all or part of the measurement wavelengths in the absorbance spectrum data to determine the undifferentiated state of the pluripotent stem cells, based on an analytic model created in advance using a plurality of types of control culture media used to culture pluripotent stem cells,

wherein the plurality of types of control culture media comprises:

a medium used to maintain the undifferentiated state of the pluripotent stem cells; and

at least one type of differentiation-inducing medium selected from the group consisting of a medium in which the differentiation into ectodermal cells is induced, a medium in which the differentiation into mesodermal cells is induced, and a medium in which the differentiation into endodermal cells is induced, and

the test culture medium is used for culture of the pluripotent stem cells or a used culture medium.

2. The method according to claim 1, wherein the plurality of types of differentiation-inducing media comprises the medium in which the differentiation into ectodermal cells is induced, the medium in which the differentiation into mesodermal cells is induced, and the medium in which the differentiation into endodermal cells is induced.

3. The method according to claim 1 or 2, wherein the medium for inducing differentiation into ectodermal cells comprises at least one factor to be

added selected from the group consisting of: SB431542, Noggin, Dorsomorphin, CKI-7 and VEGF.

4. The method according to any one of claims 1 to 3, wherein the medium in which the differentiation into mesodermal cells is induced comprises at least one factor to be added selected from the group consisting of BMP4, retinoic acid and SCF.

5. The method according to any one of claims 1 to 4, wherein the medium in which the differentiation into endodermal cells is induced comprises at least one factor to be added selected from the group consisting of Activin-A, Wnt-3a, BMP4, CHIR99021 and Wortmannin.

6. The method according to any one of claims 1 to 5, which is a method for noninvasively determining the undifferentiated state of pluripotent stem cells.

7. The method according to any one of claims 1 to 6, wherein the analytic model is created using, as an explanatory variable, the absorbance spectrum data of the plurality of types of control culture media for the wavelength light having a wavelength in the range of 190 nm to 2,500 nm or a partial range thereof.

8. The method according to any one of claims 1 to 7, wherein the analytic model is created using, as objective variables, the contents of an extracellular metabolite in the plurality of types of control culture media.

9. The method according to claim 8, wherein the extracellular metabolite is at least one selected from the group consisting of L-glutamic acid, L-alanine, ammonia, ornithine, 2-aminoadipic acid, deoxycytidine, glutamic acid, tryptophan, aspartic acid, alanine, cystine, hypoxanthine, uridine, 2-hydroxybutyric acid, 2-hydroxyvaleric acid, 3-hydroxyvaleric acid,

2-hydroxyisovaleric acid, 3-hydroxyisovaleric acid, urea, 4-hydroxybenzoic acid, 4-aminobenzoic acid and ribonic acid.

10. The method according to any one of claims 1 to 9, wherein the analytic model is created by regression analysis that is a PLS method.

11. The method according to any one of claims 1 to 10, wherein the test culture medium and the control culture media are used culture media which have been replaced by medium replacement.

12. The method according to claim 11, wherein the time period of the medium replacement is 24 to 48 hours.

13. A method for subculturing pluripotent stem cells, comprising the steps of:

collecting cells necessary for subculture; and

removing cells unnecessary for culture and/or subculture,

wherein the cells necessary for subculture are pluripotent stem cells determined to be undifferentiated cells by the determination method according to any one of claims 1 to 12, and

wherein the cells unnecessary for culture and/or subculture are pluripotent stem cells determined to be cells that have started to differentiate by the determination method according to any one of claims 1 to 12.

14. A cell culturing device comprising:

an irradiation unit that irradiates a test culture medium in which pluripotent stem cells are cultured with wavelength light having a wavelength in the range of 190 nm to 2,500 nm or a partial range thereof;

a detection unit that detects the reflected light, transmitted light or transmitted reflected light of the wavelength light applied to the sample; and

a data analysis unit that analyzes the absorbance at all the measurement wavelengths or specific measurement wavelengths in the absorbance spectrum data to determine the undifferentiated state of the pluripotent stem cells, based on an analytic model created in advance using a plurality of types of control culture media used to culture pluripotent stem cells,

wherein the plurality of types of control culture media comprises:

a medium used to maintain the undifferentiated state of the pluripotent stem cells; and

at least one type of differentiation-inducing medium selected from the group consisting of a medium in which the differentiation into ectodermal cells is induced, a medium in which the differentiation into mesodermal cells is induced, and a medium in which the differentiation into endodermal cells is induced, and

the test culture medium is used for culture of the pluripotent stem cells or a used culture medium.

15. The device according to claim 14, further comprising a spectral split unit that spectrally splits the light before or after the irradiation.

16. The device according to claim 14 or 15, wherein the data analysis unit creates the analytic model using the plurality of types of control culture media used to culture pluripotent stem cells.