CLAIMS

1. A liquid auto fraction apparatus for column chromatography comprising:

a microtube mounting portion in which a plurality of microtubes for accommodating liquids to be fractionated according to column chromatography are mounted;

a liquid supply unit configured to sequentially supplying the liquids to the plurality of microtubes;

a light source unit provided on a rear side of the plurality of microtubes to emit light;

an image acquisition unit provided on a front side of the plurality of microtubes to acquire images of the plurality of microtubes at preset time intervals while column chromatography is performed;

a volume determination unit configured to extract heights of water surfaces of the accommodated liquids by using a phenomenon in which light emitted by the light source unit passes through the microtube and is refracted by the liquid accommodated in the microtube and by analyzing the images of the plurality of microtubes acquired by the image acquisition unit and configured to determine whether volumes of the liquids accommodated in the plurality of microtube reach a target volume based on the extracted heights of the water surfaces; and

a control unit configured to set a reference value for determining whether the volumes reach the target volume and configured to control operations of the liquid supply unit and the image acquisition unit according to a determination result of the volume determination unit.

2. The liquid auto fraction apparatus of claim 1, wherein the microtube mounting portion is composed of a plurality of grooves formed in a housing to accommodate the plurality of microtubes, and

the plurality of grooves are arranged in a row at preset intervals on a straight line.

3. The liquid auto fraction apparatus of claim 2, wherein a reference microtube accommodating a liquid of the target volume is mounted in a first groove among the plurality of grooves, and

the plurality of microtubes for fractionation are mounted in the other grooves.

4. The liquid auto fraction apparatus of claim 2, wherein the liquid supply unit includes:

a column including a stationary phase and a mobile phase;

a column support coupled to the housing so as to be movable along a linear axis parallel to the straight line on which the plurality of grooves are formed and configured to support the column such that the column is sequentially movable at a position corresponding to the plurality of microtubes; and

a drive unit coupled to a lower end of the column support and configured to move the column such that the column is located on an upper portion of one of the plurality of microtubes as column chromatography is performed.

5. The liquid auto fraction apparatus of claim 4, wherein the image acquisition unit includes:

a camera installed to be sequentially movable from the position corresponding to the plurality of microtubes and configured to acquire images of the plurality of microtubes;

a movement shaft that is parallel to the straight line on which the plurality of grooves are formed and on which the camera moves; and

a drive unit configured to move the camera on the movement shaft such that the camera is located in front of the plurality of microtubes as the column

chromatography is performed.

6. The liquid auto fraction apparatus of claim 1, wherein the volume determination unit analyzes the images each of the plurality of microtubes obtained by the image acquisition unit at the preset time intervals and determines whether the volumes reach the target volume by using only an image with a standard deviation of the extracted height of the water surface that is less than or equal to a preset value.

7. The liquid auto fraction apparatus of claim 1, wherein the volume determination unit finds boundary surfaces of refracted images among the images of the plurality of microtubes, extracts the heights of the water surfaces, and compares the heights of the water surfaces with the reference value to determine whether the volumes reach the target volume.

8. The liquid auto fraction apparatus of claim 7, wherein the volume determination unit sums all R-channel values of pixels on respective horizontal lines in the image of each of the plurality of microtubes for each horizontal line and extracts a position of the horizontal line in which the sum of the R-channel values is greatest as the height of the water surface, and determines that the volume reaches the target volume when the height of the water surface exceeds the reference value.

9. The liquid auto fraction apparatus of claim 1, further comprising:

a display unit implemented as a touch screen to display buttons for receiving signals relating to operations of the liquid auto fraction apparatus, to visualize a performance state of the column chromatography as graphics, and to display the visualized performance state.

10. The liquid auto fraction apparatus of claim 3, wherein the control unit acquires and analyzes an image of the reference microtube to extract a height of a water surface and sets the extracted height as the reference value.

11. The liquid auto fraction apparatus of claim 1, wherein the control unit checks whether alignment of the plurality of microtubes and the light source unit is correct based on brightness of the images of the plurality of microtubes, and corrects a position of the image acquisition unit when the alignment is not correct.

12. The liquid auto fraction apparatus of claim 11, wherein the control unit sums R-channel values of respective pixels on a central vertical line in the image of each of the plurality of microtubes, and determines that alignment of the plurality of microtubes and the light source unit is correct when the summed value is greater than or equal to a preset value.