SEPARATION OF BIOGENIC MATERIALS BY ELECTROPHORESIS UNDER ZERO GRAVITY
L-3

Masao Kuroda
Osaka University Medical School
Japan

Outline of Flight Experiment

Electrophoresis separates electrically charged materials by imposing a voltage between electrodes. Though free-flow electrophoresis is used without carriers such as colloids to separate and purify biogenic materials including biogenic cells and proteins in blood, its resolving power and separation efficiency is very low on Earth due to sedimentation, floatation, and thermal convection caused by the specific gravity differences between separated materials and buffer solutions.

The objective of this experiment is to make a comparative study of various electrophoresis conditions on the ground and in zero-gravity in order to ultimately develop a method for separating various important "vial" components which are difficult to separate on the ground.

A schematic of a free-flow electrophoresis apparatus is shown in Figure 1. Several free-flow electrophoresis devices have been developed. Since all electrophoresis devices utilize an electric field, Joule heat is generated. This heating causes convection currents in the sample solution, which disrupts the separated sample bands and therefore limits the separation ability.

In space we may be able to obtain improved separations of important biological samples which are difficult to separate on the ground because of the absence of floating or sedimentation of the sample due to concentration differences, or the convection current due to Joule heat.

In the FMPT experiment, we will examine the differences in separations obtained on Earth and those performed in microgravity, and investigate the effects of various separative conditions using samples composed of several mixed proteins.

Ground-Based Experiments

Preliminary ground-based experiments were performed in a small free-flow electrophoresis chamber (width 60 mm, height 100 mm, thickness 0.8 mm). The chamber thickness is less than that of the flight chamber to allow more efficient cooling of the chamber buffer which is necessary to control Joule heating.

In the preliminary experiment, we tested the electrophoresis of a mixture of various proteins (Cytochrome C, Bovine Serum Albumin, Trypsin-inhibiter, etc.) in preparation for the flight experiment.

The results obtained are shown in Figures 2 and 3. These results are as expected. Since separation ability was still not optimum, we plan to examine how these proteins separate in space.

Objectives of the Flight Experiment

We will use a sample composed of a mixture of proteins to investigate the effects of varying the following experiment parameters on the separation efficiency.

1. Comparison of separation ability by the change of the velocity of a flowing buffer liquid.

2. Comparison of separation ability based on the change of the electrophoresis voltage.

3. Comparison of separation ability by the change of the volume of infusing sample.

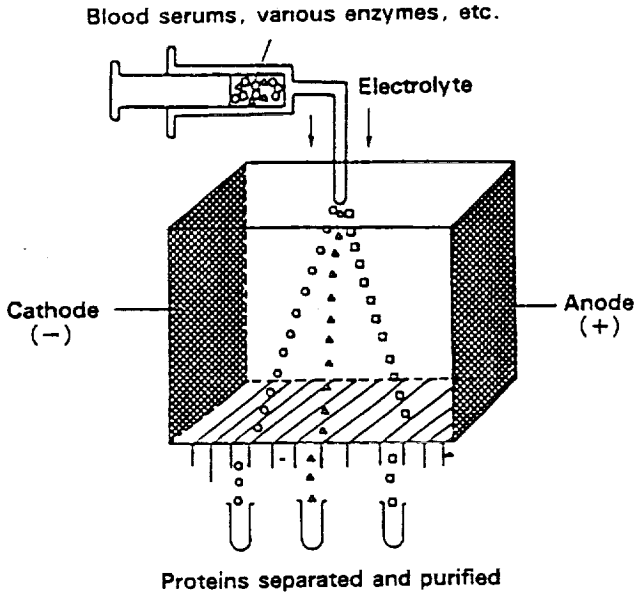

Figure 1. Schematic of Electrophoresis Chamber.

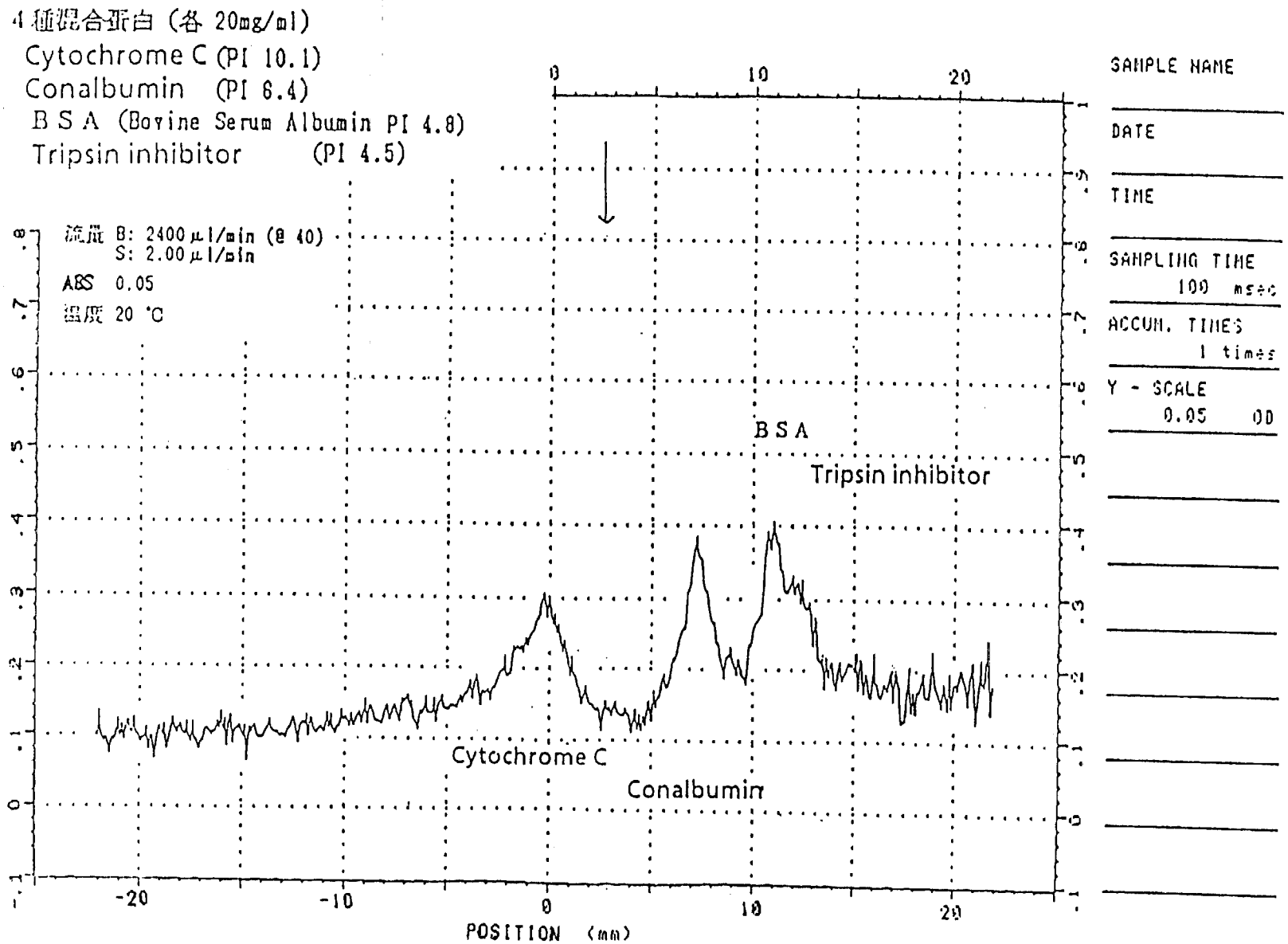

Figure 2. Electrophoresis separation of mixed proteins (BBM).

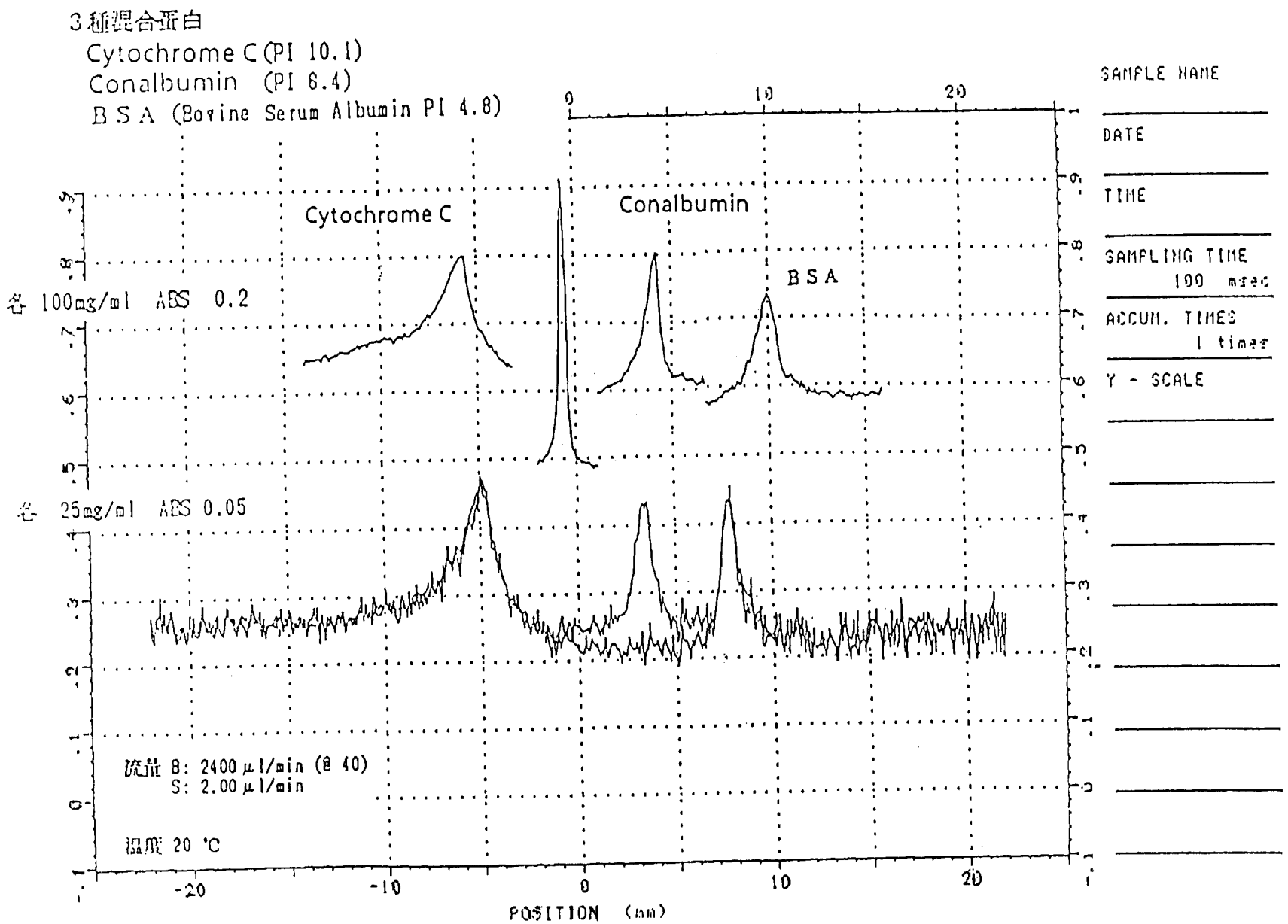

Figure 3. Electrophoresis separation of mixed proteins (BBM).

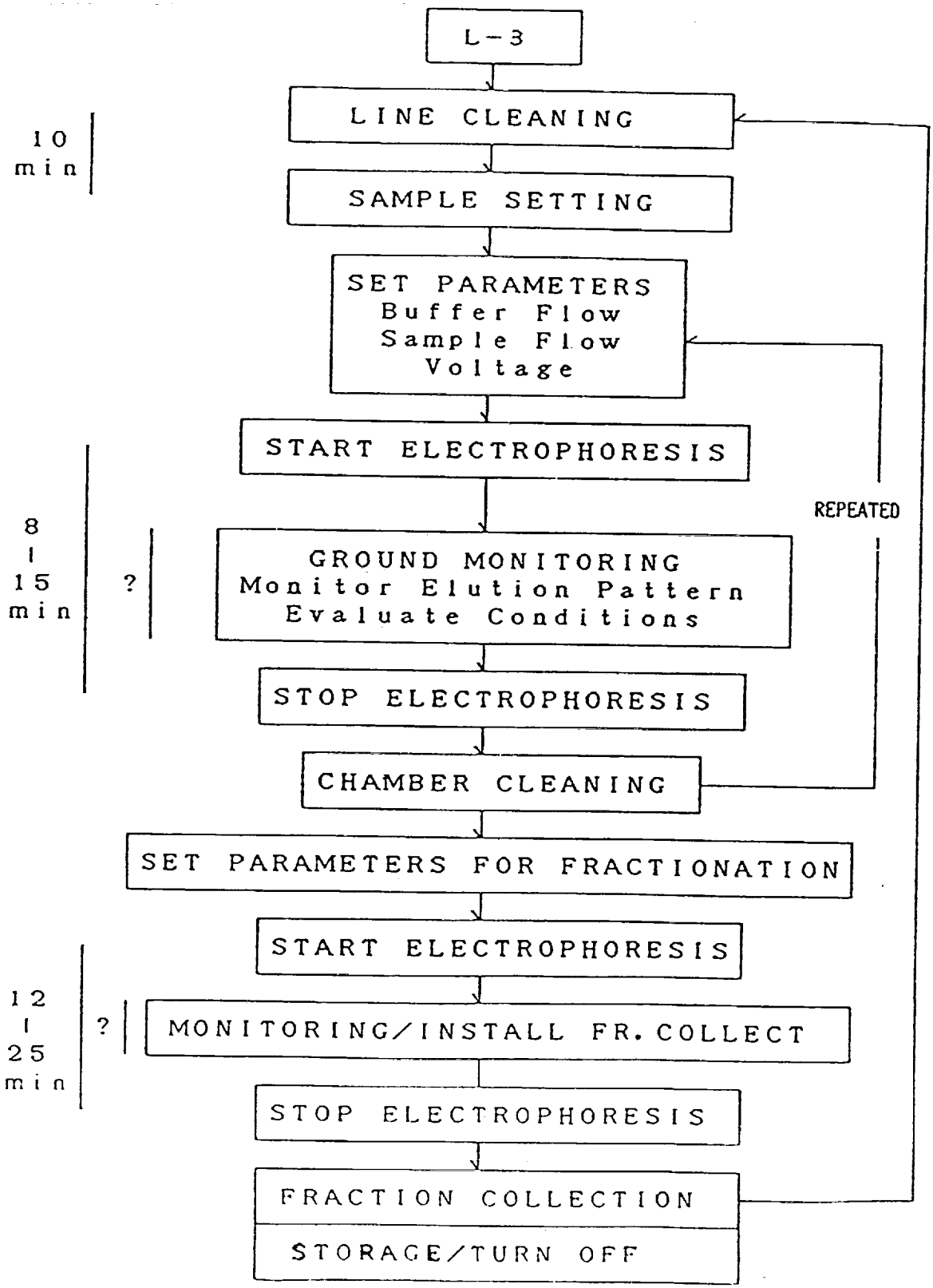

Figure 4. Electrophoresis experiment operations.