



Thermal Denaturation of Proteins Using the Hitachi Differential Scanning Calorimeter

Differential Scanning Calorimetry (DSC) was employed to evaluate the thermal stability of representative proteins under controlled experimental conditions. Measurements on lysozyme, myoglobin, and albumin demonstrate that denaturation profiles are sensitive to both protein type and sample concentration, with distinct transition temperatures observed across systems. The results highlight the importance of optimized conditions—particularly dilute concentrations and low heating rates—to minimize aggregation effects and ensure accurate thermal characterization.

Keywords or phrases:

Differential Scanning Calorimetry (DSC), protein denaturation, thermal stability, lysozyme, myoglobin, albumin, Hitachi DSC

INTRODUCTION

Protein takes a specific three-dimensional structure to maintain biological functions in aqueous solution. When the protein is heated, thermal motion and other factors break down the protein structure. This is known as thermal denaturation. In general, heat is absorbed during thermal denaturation of protein and DSC can observe this endothermic phenomenon.

If the sample concentration is high, molecular interactions (aggregation) may occur. Therefore, it is advisable to dilute the solution as much as possible when using DSC to measure the thermal denaturation of protein. Furthermore, it is advisable to use a low heating rate, when considering the speed of the thermal denaturation of protein and the internal temperature distribution of the measurement sample. In general, the heating and cooling rate during measurement is 1°C/min or less. These conditions require the use of high sensitivity DSC.

In this brief, Super High Sensitive DSC is used to measure the thermal denaturation of protein.

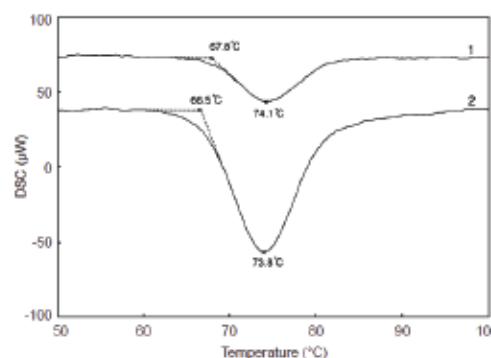


Figure 1: DSC Results for Lysozyme
1: 1% solution
2: 3% solution

MEASUREMENTS

Three samples were measured: lysozyme, myoglobin and albumin. The lysozyme was manufactured by Seikagaku Corporation (and refined six times). The myoglobin and albumin were manufactured by Sigma.

For the measurements, a DSC120 Super High Sensitive Differential Scanning Calorimeter was connected to a SSC5200H Disk Station.

The protein measurement samples were prepared at prescribed concentrations, and the weight was approximately 50 mg. Measurement samples were placed in a sealed container (70 μ l) made of silver. The heating rate was 1°C/min.

RESULTS

Figure 1 shows the measurement results for the 1% and 3% lysozyme solution. Even in a dilute 1% solution and at a low heating rate of 1°C/min, a thermal denaturation peak is observed.

Figure 2 shows the measurement results for the 1% lysozyme and myoglobin solutions and for the 3% albumin solution. Different protein types had different denaturation temperatures, indicating differences in thermal stability.

SUMMARY

In this brief, DSC was used to measure protein. DSC measurement can observe the endothermic phenomenon that accompanies the thermal denaturation of protein. This method is effective in evaluating the thermal stability of proteins.

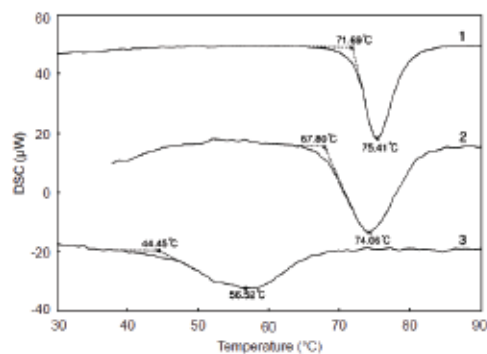
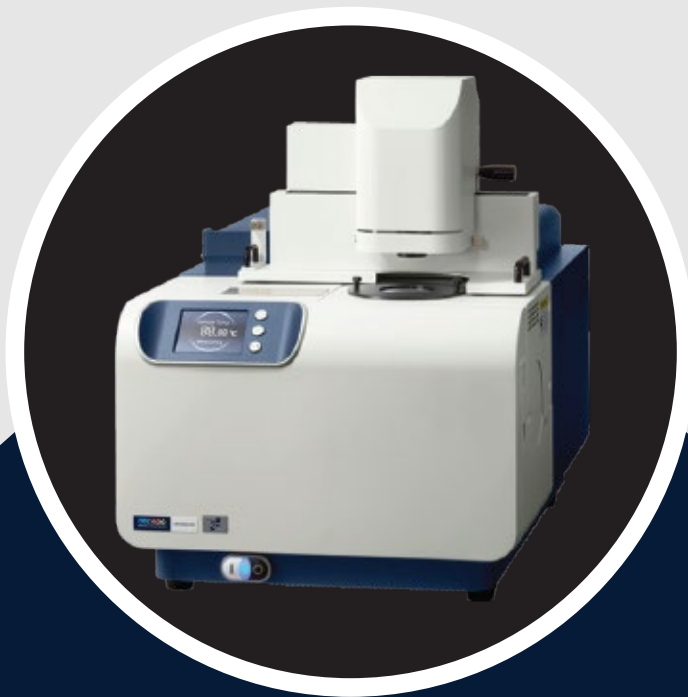


Figure 2: DSC Results for Lysozyme, Myoglobin and Albumin
1: 1% Myoglobin solution
2: 1% Lysozyme solution
3: 3% Albumin solution



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