

## Thermal Denaturation of Proteins I

— The Effects of Salt and Sugar Additives and pH —

### 1. Introduction

Information of the thermal denaturation of protein is crucial in biological and food industries. It is well-known that thermal characteristics of protein are affected by factors such as pH, ion intensity, and protein concentration.

In this brief, we investigate how the denaturation peaks of ovalbumin change with changes in pH and sugar and salt concentrations. Ovalbumin is the main protein in egg white, which is commonly used in sweets and cooking.

### 2. Measurements

For the measurements, a DSC100 Super High Sensitive Differential Scanning Calorimeter was connected to a SSC5000 Disk Station.

For the measurements, 20 mg of buffer solution, sugar water or sodium chloride was added to 10 mg of ovalbumin to produce prescribed pH, sucrose concentration, or salt concentration levels, resulting in a measurement sample weight of approximately 30 mg. Measurement samples were placed in a silver sealed container (70  $\mu$ l). The heating rate was 1°C/min.

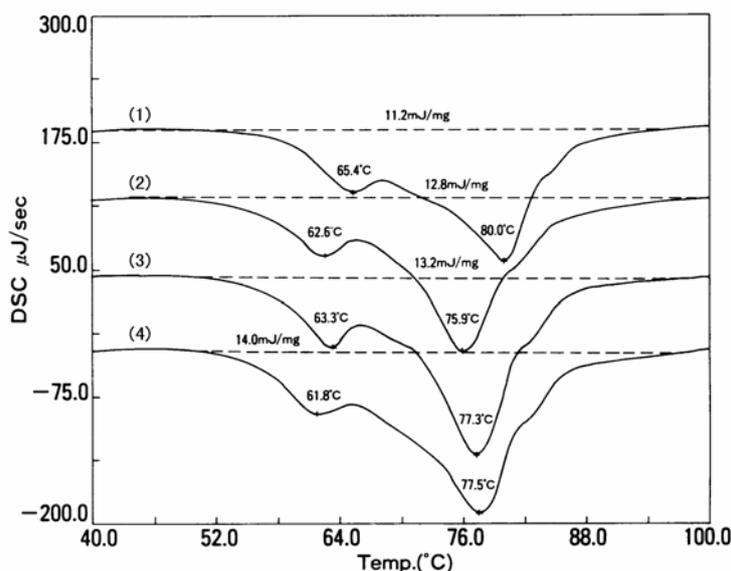


Figure 1 The Effects of pH on the Thermal Denaturation of Ovalbumin

- (1) pH 1.68
- (2) pH 4.01
- (3) pH 6.86
- (4) pH 10.01

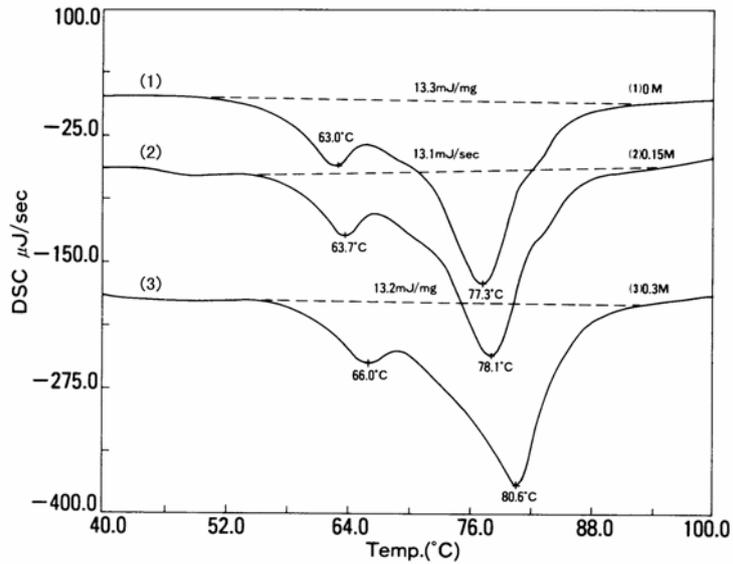


Figure 2 The Effects of Sucrose on the Thermal Denaturation of Ovalbumin  
 (1) Sucrose 0M  
 (2) Sucrose 0.15M  
 (3) Sucrose 0.30M

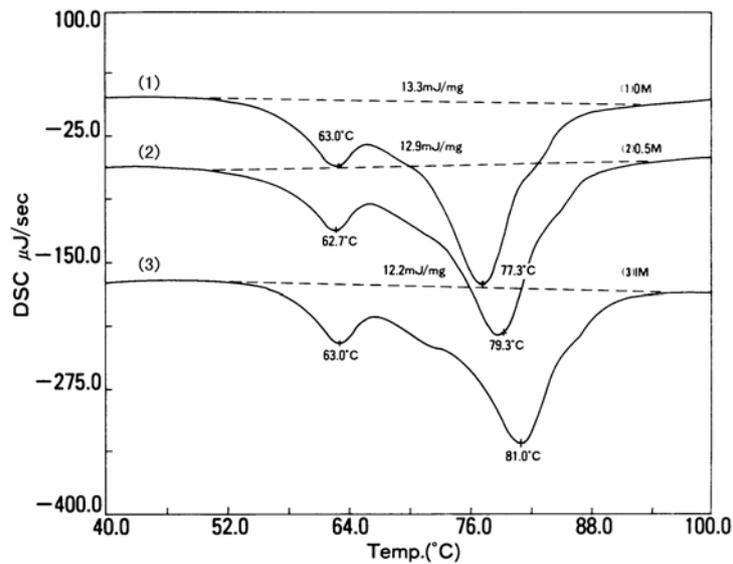


Figure 3 The Effects of Salt Concentration on the Thermal Denaturation of Ovalbumin  
 (1) NaCl 0M  
 (2) NaCl 0.5M  
 (3) NaCl 1M

### 3. Results

#### 3-1 The Effects of pH

Figure 1 shows the DSC measurement results for the ovalbumin at different pH levels. When the pH was increased, the heat of denaturation rose and the peak temperature in the vicinity of 60 °C tended to shift lower.

### 3-2 The Effects of Sugar Additives

Figure 2 shows the DSC results for the ovalbumin at different sucrose concentrations. The results show that when the sucrose concentration was increased, the denaturation temperature peaks tended to shift higher.

### 3-3 The Effects of Salt Concentration

Figure 3 shows the DSC measurement results for the ovalbumin at different NaCl concentrations. The results show that when the salt concentration was increased, the heat of denaturation decreased and the temperature peak in the vicinity of 80 °C tended to shift higher.

## 4. Summary

Eggs are widely used in sweets and cooking because they are high in nutrients, easy-to-use and cheap. In this brief, we investigated the effects of salt, sugar, acidity and alkalinity on the denaturation of ovalbumin.

When egg whites are whisked during cooking, air bubbles coagulate the egg whites. Sugar is often added to delay the coagulation and create soft foam. The DSC results show that the addition of sugar shifts the denaturation temperature of ovalbumin higher and this indicates that DSC can be used to evaluate the stability of protein.