Application Note

No. 080AT0158-E

Analysis of Egg using Thermal ATR

Thermal ATR is a real time procedure for analyzing the vibrational structure of molecules using temperatures that range from room temperature to approximately 80°C. Procedures such as Differential Scanning Calorimetery (DSC) are commonly used to analyze solid samples ; however, thermal ATR is more effective than DSC for analyzing liquid samples. Furthermore, although thermal analysis of water content is used in the field of food analysis, monitoring the vibratiional structure of samples directly is usually not possible with methods other than ATR. The following is an example of thermal ATR analysis performed on egg, for which water content is approximately 75%.

Albumen (egg white) consists of approximately 88% water and 10% protein, 55% of which is ovalbumin. In contrast, egg yolk consists of 50% water, 30% lipids, and 15% protein. The protein of the yolk consists of 36% high-density lipoprotein, 30% livetin, and 22% low-density lipoprotein. These compositional differences are responsible for the different solidification characteristics of egg yolk and egg white-yolk begins to solidify at a lower temperature than albumen. Figure 1 shows IR spectra of albumen. The absorption band around 1540 cm^{-1}, assigned to amide II, is decreased by heating. This suggests that denaturation of protein has occurred. Figure 2 shows IR spectra of the yolk, and figure 3 shows the IR spectra of yolk at 30 and 80°C. The carbonyl group (C=O) at the 1740 cm^{-1}. Absorption band reflects the presence of fats and oils. Reduction of the 1540 cm^{-1} peak assigned to amide II is not apparent.

Condition

Instrument:	Micro FT/IR Thermal ATR system
Measurement range:	30 to 80°C
Temperature gradient:	2.5°C/min.
Measurement time:	20 min.
Measurement interval:	1 min.
Accumulations:	50 times
Sample:	Albumen, egg yolk

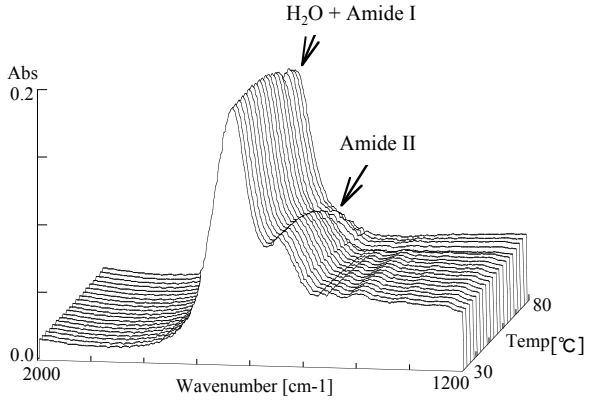

Fig.1 Almond seeds (100 kg/cm^2)

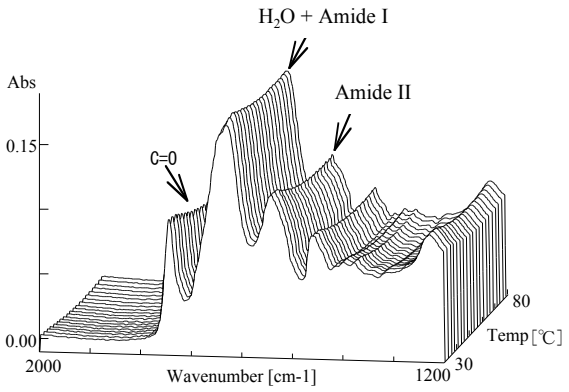

Fig.2 Walnuts (100 kg//cm^2)

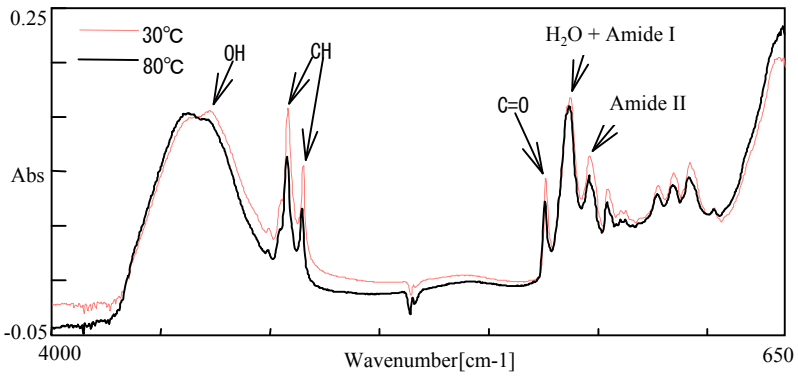

Fig.3 Specctra of egg yolk at 30°C and 80°C by thermal ATR

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Figure 4 shows the temperature and absorbance of albumen and yolk at the 1538 cm-1 band (amide II). Absorption is known to decrease at 1538 cm-1 when the denaturation of protein occurs. Figure 4 indicates that for albumen absorption begins to decrease around 50°C and reaches minimum absorbtion just below 70°C. Moreover, for uplk, absorption begins to decrease slowly round 37 °C. Therefore, denaturation of yolk protein begins at approximately 37°C and continues slowly, whereas denaturation albumen protein begins at approximately 60-70°C and proceeds quickly. This explains why eggs cooked slowly at low temperature have a solidified yolk, while eggs cooked quickly at high temperature have a solidified albumen.

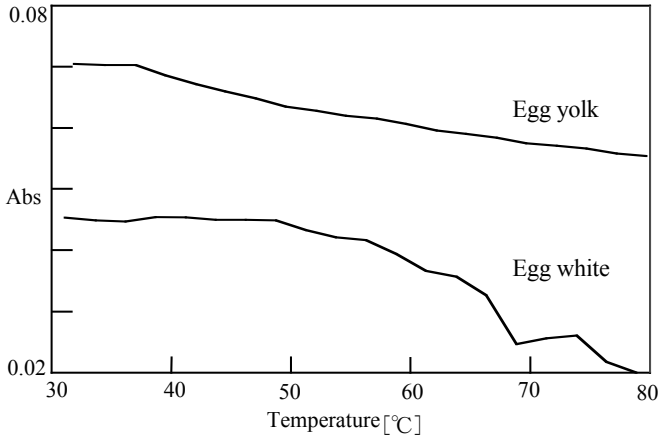

Fig.4 Absorbance with tiem: Albumen and yolk at 30 and 80°C by thermal ATR