SHIMADZU

Application News

Thermal Analysis No.T147

Protein Denaturation and Texture Analysis for Chicken

■ Introduction

The deliciousness of food is greatly influenced by taste due to chemical interactions with the tongue for the basic tastes of sweetness, saltiness, acidity, bitterness, and umami (also referred to as savoriness), in addition to the physical sensations of hardness and softness and juiciness sensed by the teeth. In particular, texture, which includes the sensations of juiciness and softness, is an important factor related to the deliciousness of fried foods, such as fried chicken. Here we conducted an overall evaluation of texture in fried chicken heated over different time periods. DSC was to measure protein denaturation, and a precision universal testing machine was used to measure the hardness and elasticity.

■ Protein Denaturation of Chicken

Chicken breast seasoned with spices was placed in an aluminum sealed cell, and heated at rate of 10 ˚C/min. Endothermic peaks were seen at 57 ˚C, 64 ˚C and 78 ˚C.
It is presumed that the endothermic peaks correspond to denaturation of myocin at 57 ˚C, connective tissue at 64 ˚C, and actin at 78 ˚C.

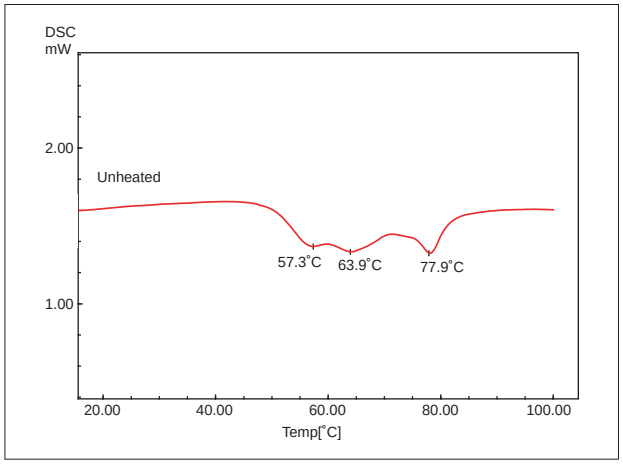

Fig. 1 DSC Curve of Chicken

■ Protein Denaturation at Different Heating Times

After confirming that the temperature at the center of frying chicken breasts was 70 ˚C, the chicken breasts were kept warm for 0 min, 1 hour, 2 hours, and 4 hours, respectively, at which times the chicken breasts were immediately frozen by shock freezing. Before conducting DSC measurement of the frozen samples, they was defrosted and placed in an aluminum sealed cell, and heated at a rate of 10 ˚C/min up to 100 ˚C. An endothermic peak due to denaturation of the protein actin is seen within one hour of heat retention. This means that un-denatured protein still remains. On the other hand, when heat retention continues beyond 2 hours, no endothermic peaks are seen, and the softness is lost. Thus, this correlates to the experience that the longer heat retention continues, the dryer the texture becomes.

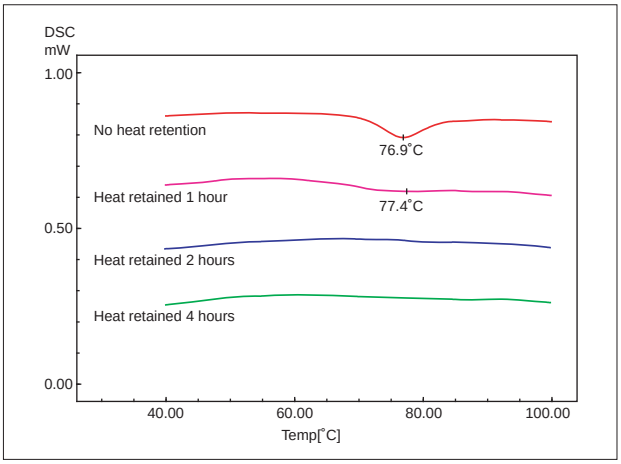

Fig. 2 DSC Curves of Fried Chicken Subjected to Different Heat Retention Times

■ Hardness and Elasticity Due to Different Heat Retention Time

Next, the chicken breast fiber was evaluated for hardness by orthogonal shearing, and for elasticity. Table 1 shows the testing conditions, and Fig. 4 shows the force and time graph. Fig. 6 shows the definition of parameters used to indicate texture. Hardness is indicated by the maximum force first applied, and elasticity is indicated as a ratio of the recovery times after applying the load twice. Table 2 shows the hardness and elasticity calculated based on these test results. It is clear that while the hard-ness rose marginally up to a heat retention time of 1 hour, the specimen suddenly becomes harder after heat retention exceeds 2 hours. This also correlates to the DSC measurement result in which protein denaturation is seen within one hour.

Fig. 3 Photograph of AGS-X System

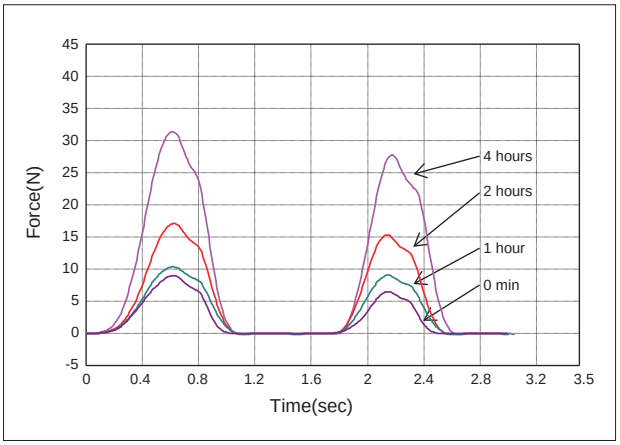

Fig. 4 Relation between Force and Time

Table 1 Testing Conditions

Testing Instrument	AGS-X
Load Cell	1 kN
Jig	Tooth-shaped push rod
Test Speed	750 mm/min
Clearance	5 mm (shear indentation amount)
Number of Load Cycles	2 cycles
Software	TRAPEZIUMX (Texture)
Sample Dimensions	About 20 × 20 × 10 mm

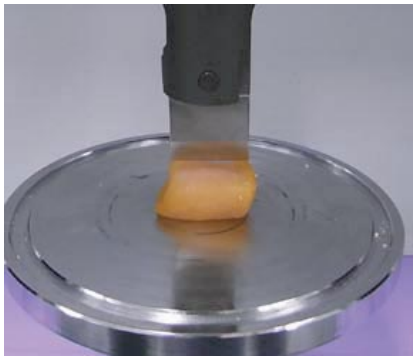

Fig. 5 Starting Status of Shear Test

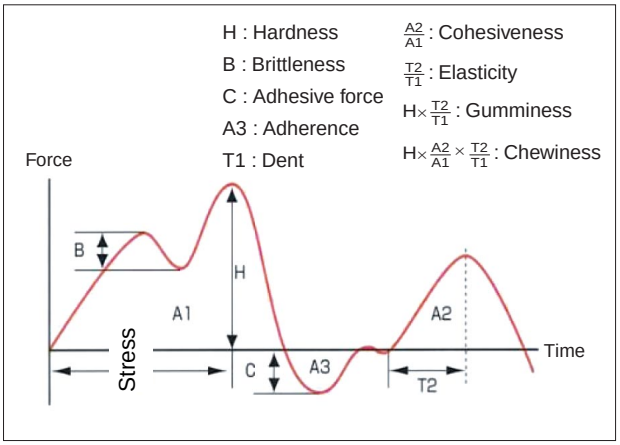

Fig. 6 Texture-Related Parameters

Table 2 Test Results

Heat Retention Time	Hardness (N)	Elasticity
0 min	8.87	1.33
1 hour	11.50	2.05
2 hours	16.83	2.98
4 hours	32.77	5.72

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Printed in Japan 3295-06007-10A-IK