SHIMADZU

# Application News

Material Testing System No.226

## Multifaceted Measurement of Plums Pickled in Plum Wine

### 1. Introduction

Plum is not only a food but also used as a medicinal foodstuff to recover from fatigue and treat food poisoning. There are many types of plums such as the well-known Gojiro, Shirakaga, Sugita, Akebono, and Nankoh varieties. Yellowish unripened plums are used to make pickled plums and plum wine.
Texture and smell of four types of store-bought plums pickled in plum wines were converted into numerical values for comparison. The analysis and measurement items are listed below.

(1) Measurement of hardness and elastic quality which corresponds to chewiness using the EZ Test Shimadzu Compact Table-Top Testing Machine
(2) Fluoroscopy of the inside of fruit flesh using the SMX-1000 Shimadzu Microfocus X-Ray Inspection System to see how pickled it is.

### 2. Measurement of Elastic Quality of Pickled Plums

Fig. 1 is a photo of elasticity measurement where fruit flesh was penetrated to a depth of 6 mm twice by a 0.5R penetration elasticity test jig.


**Fig. 1 Penetrating Test Performed on Pickled Plum**

Figs. 2-1 to 2-4 show the force (penetrating resistance [N]-vertical axis)-displacement (penetrating depth [mm]-horizontal axis) curves obtained using TRAPEZIUMX Texture software. In the curves, the higher the highest peak is, the harder the plum. The deeper the lower peak of the curve below the horizontal axis is, the higher the cohesiveness. And, the greater the height ratio between the height of the moderate curve slightly above the horizontal axis and the highest peak is, the higher the elasticity. In the test performed, the result was A≈B>D>C for all hardness, elastic quality, and cohesiveness.

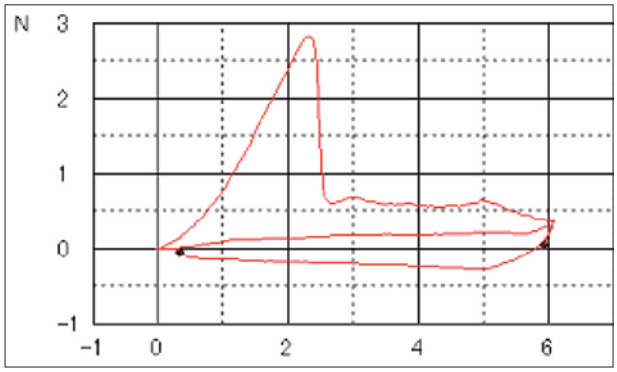


Fig. 2-1 Pickled Plum A

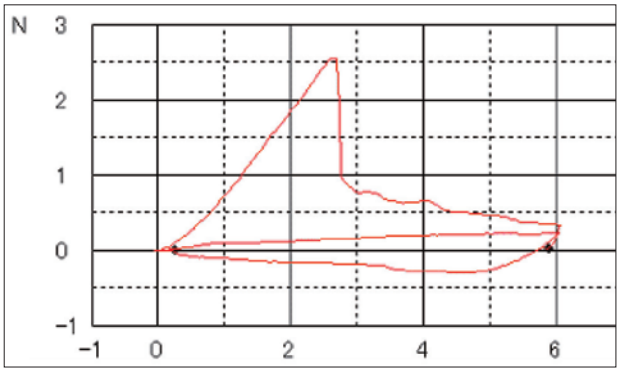


Fig. 2-2 Pickled Plum B

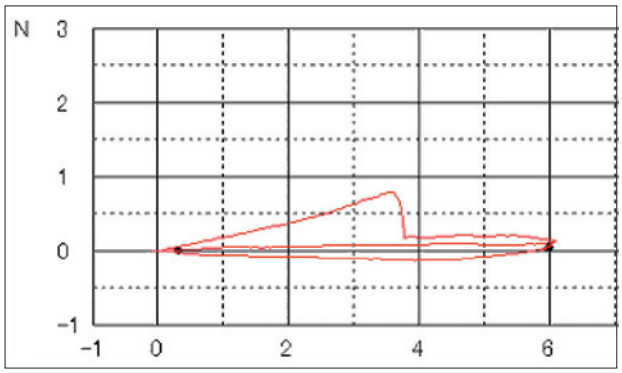


Fig. 2-3 Pickled Plum C

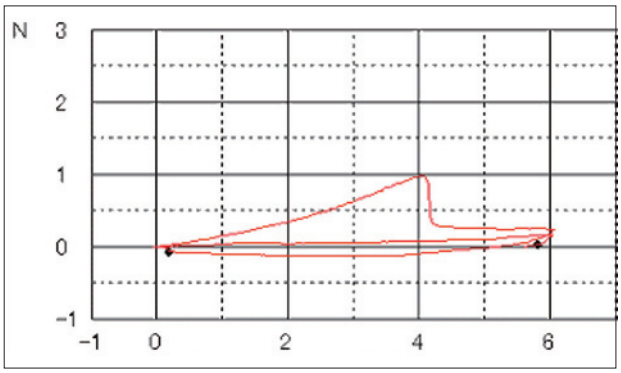


Fig. 2-4 Pickled Plum D

Fig. 2 Force-Displacement Curve After Piercing Pickled Plums Twice

### 3. Fluoroscopic Observation of the Inside of Pickled Plums Using the X-Ray Inspection System

X-ray fluoroscopy was performed on pickled plums A through D at a certain fluoroscopic magnification and resolution (X-ray tube voltage 90 kV, X-ray tube current 110 μA, magnification 5×). The results are shown in Figs. 3-1 to 3-4. In general, areas with a higher density are displayed darker (blacker) and areas with a lower density are displayed lighter (whiter) in fluoroscopic images. In Figs. 3-1 to 3-4, darkness of pickled plums A and B are similar, which indicates that the density of fruit flesh is relatively high. The entire fruit flesh of pickled plum C looks whitish, which indicates that liquid (distilled spirit in this case) has penetrated. In pickled plum D, a portion of fruit flesh close to the skin looks swollen because of liquid.

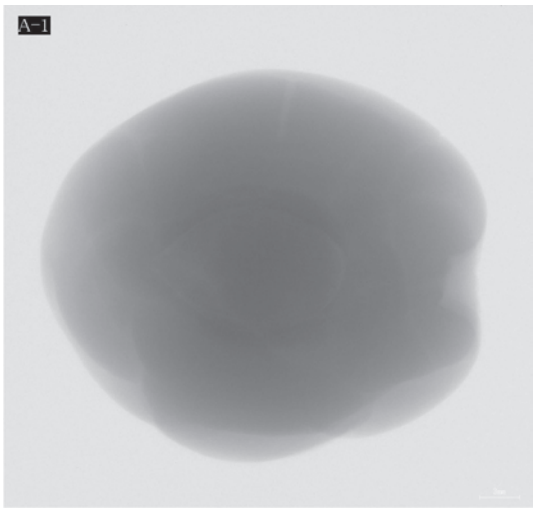


Fig. 3-1 Pickled Plum A

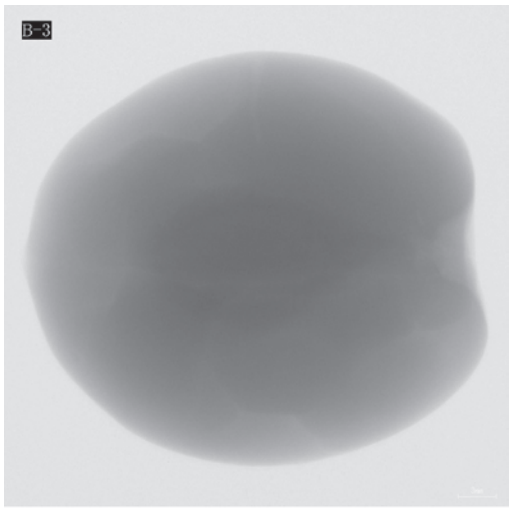


Fig. 3-2 Pickled Plum B

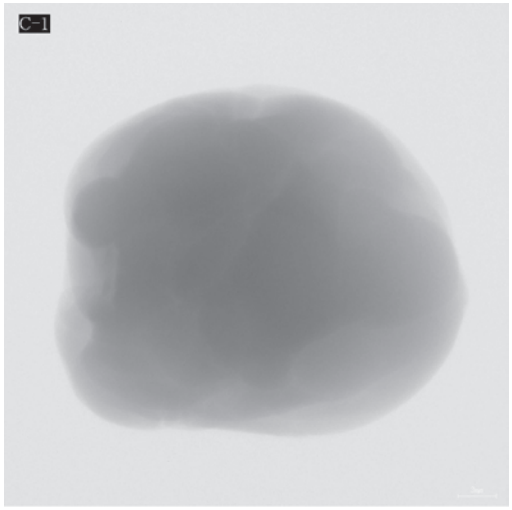


**Fig. 3-3 Pickled Plum C**

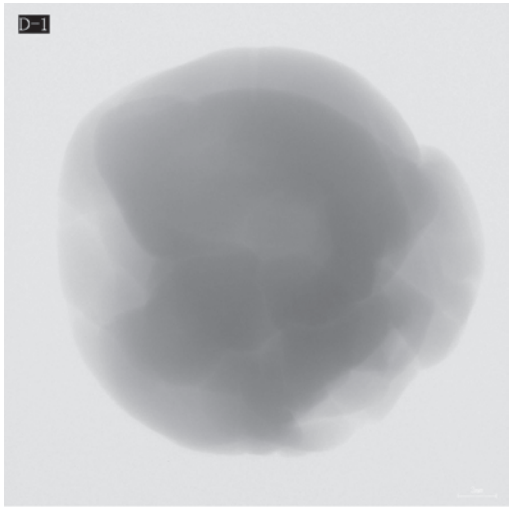


**Fig. 3-4 Pickled Plum D**

According to the above, the degree of penetration of distilled spirit (degree of swelling) was evaluated to be A≈B>C>D.
The result was the same as how people felt (how pickled the plums were) when they put the plums in their mouth. However, the order of plums for hardness, elasticity, and cohesiveness was different from the data.

**Fig. 4 SMX-1000 Shimadzu Microfocus X-Ray Inspection System**

## 4. Summary

In the test, pickled plums were evaluated by a mechanical test, image observation.
Although the results were sufficiently convincing, multifaceted analysis and measurement are believed to help convert the texture of food into numerical values.

SHIMADZU

**SHIMADZU CORPORATION. International Marketing Division**
3. Kanda-Nishikicho 1-chome, Chiyoda-ku, Tokyo 101-8448, Japan Phone: 81(3)3219-5641 Fax. 81(3)3219-5710
Cable Add.:SHIMADZU TOKYO