Short Paper

Calculation for an Index of Disintegration due to Penetrating Strength in Fish Paste Products

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Studies of disintegration known as "*himodori*" during the manufacture of fish paste products such as "kamaboko" have been carried out by several researchers,^{1,2)} but the ease of disintegration in several fish species has usually been measured by the tensile strength alone.^{3,4)}

In this paper, investigations were made in order to obtain values corresponding to an index of disintegration from tensile strength, using penetrating strength which is widely used for the quality evaluation of fish paste products.

Unsalted Alaska pollack *Theragra chalcogramma* frozen surimi (MARUHA Co. Ltd., SA-grade) was used for preparing the fish paste products. The surimi was thawed up to 5°C in flowing water of 15°C, then was minced and ground by a speed cutter (National, MK-K3) for 5 min in a cold room at 5°C to prepare fish paste, adding 3% NaCl and some water to make up to 80% of final moisture content. To obtain a heat-induced gel, the prepared fish paste was charged into a sample holder aluminum pipe (32 mm in inner diameter, 28 mm in height, 0.2 m in thickness) and heated at 55, 60, 63, and 65°C for 20 and 120 min in a water bath. The heat-induced gel was cooled to 5°C by cold water immediately after heating and was kept at the same

temperature over night to equilibrate it.

The penetrating strength (PS) [g/cm²] was expressed as the force per unit area of the contact surface of the plunger at 5 mm penetration. The PS was measured by a rheometer (Yamadan, RE-3305) equipped with a cylindrical-plunger with a cross section of 0.196 cm² at 1 mm/s compression speed. The tensile strength (TS) was obtained by the method of Shimizu *et al.*³⁾ using rheometer at 1 mm/s tension speed.

Thus the values of the disintegration index (X [%]) obtained from the PS were calculated by the following equation (1), substituting PS₁₂₀/PS₂₀ for Se₁₂₀/Se₂₀ in the formula of Shimizu *et al.*

$$X = [1 - (PS_{120\text{min}}/PS_{20\text{min}})] \times 100 \quad (1)$$

where, PS_{120min}: penetrating strength of the heat-induced gel after heating for 120 min, g/cm²

PS_{20min}: penetrating strength of the heat-induced gel after heating for 20 min, g/cm²

The resulting relationship between the logarithm of the values of the disintegration from the TS and the values of the disintegration index from the PS are shown in Fig. 1. The positive regression Eq. (2) was obtained with high correlation ($r=0.98$) as follows.

$$\log Y = 0.03X + 0.58 \quad (2)$$

where, X : index of disintegration obtained from the PS [g/cm²] by the Eq. (1), %

Y : index of disintegration obtained from the TS [g/cm²] by the formula of Shimizu *et al.*

The index values from 35 to 70³⁾ as the ease of disintegration were calculated using the PS.

Accordingly, it was concluded that the index values of disintegration corresponding to the usual one could be obtained from the PS instead of the TS.

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Fig. 1. Relationship between the logarithm of the values of the disintegration index from tensile strength and the values of the disintegration index from penetrating strength in heat-induced gels.

X : Index of disintegration obtained from the PS [g/cm²] by Eq. (1), %. Y : Index of disintegration obtained from the TS [g/cm²] by the formula of Shimizu *et al.*³⁾ %.