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Quantification of grittiness of yogurt using flow characteristics indexes

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Abstract

The grittiness of a food product is quantified mainly by sensory evaluation since it is difficult to use a measuring instrument for perceived texture. In this study, we examined a method for quantitatively evaluating the grittiness of yogurt according to its flow characteristics. Three categories of yogurt (15 types in total) were used as samples. Sensory evaluation (QDA: qualitative data analysis) and flow characteristics evaluation were conducted. Four trained panels evaluated the smoothness of samples using a 15-cm scale method. Distance from the left edge to the plot on a 15-cm scale was expressed using a score of 0 (smooth) to 15 (gritty) points. The mean score of the four panels (sensory evaluation score) was used for the analysis. For the flow characteristics evaluation, the yogurt was pressurized until it flowed from the reservoir and through the pipe (needle). Flow velocity and pressure of the yogurt were measured. The fluctuation frequency of the flow velocity was defined as F [1/s]. The difference between the maximum and minimum flow velocity was defined as Δv_{max} [L/s]. Grittiness was evaluated using these flow characteristics indexes. The logarithm of (average particle size \times concentration) was proportional to the sensory evaluation score. F and Δv_{max} increased in proportion to the concentration of dispersed particles. There was a correlation between F and the sensory evaluation score. There was also a correlation between Δv_{max} and the sensory evaluation score. The relationship between the sensory evaluation score and the flow characteristics indexes was examined using all the yogurts. The sensory evaluation score was a linear function of the logarithm of ($F \times \Delta v_{max}$). Therefore, it was shown that quantitative evaluation of the grittiness of yogurt was possible using the flow characteristics indexes.

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Keywords: Quantification of grittiness; Yogurt; Sensory evaluation; Flow characteristics evaluation; Flow velocity; Average particle size; Concentration of particles

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1. Introduction

Texture is an important factor in food quality and appeal. However, the complex mechanism for chewing/swallowing food makes it difficult to quantitatively measure the texture felt in the mouth [1]. Texture is closely related to the physical properties of food [2, 3]. In this study, yogurt was used as a food that shows both smoothness and grittiness. Yogurt with a high degree of grittiness is not accepted by consumers. Physical properties of yogurt vary with the manufacturing conditions [4]. Grittiness of yogurt is affected by the heating conditions of raw milk and the composition of raw materials. A method for quantitatively measuring grittiness would be useful for quality control in yogurt production. Grittiness is quantified mainly by sensory evaluation since it is difficult to use a measuring instrument for perceived texture. We note that the factors affecting grittiness (e.g., particle concentration, size, properties, and state) are in fact closely connected to the flow behavior of the yogurt in a needle. The quantitative relationship was studied between the flow characteristics indexes and the grittiness. The purpose of this study was to develop a method of evaluating the grittiness of yogurt using flow characteristics indexes.

2. Materials & Methods

2.1. Samples Yogurt

The following three categories of yogurt were used as samples for evaluation.

Model yogurt: We prepared model yogurt by adding coffee extraction residue particles to commercial yogurt. The coffee extraction residue was dried at 120°C, degreased with 70% ethanol and then air dried. The residue was ground in a hammer mill and separated into three fractions using 180- and 355- μm sieves. The medium size fraction (180–355 μm) was selected for the addition particles. The particles were used to contribute grittiness. Particle concentration was set at 0, 0.25, 0.50, 0.75, 1.00, and 2.00 wt%, and six types of yogurt with different degrees of grittiness were prepared. The appearance of the particles is shown in Figure 1.

Commercial yogurt: Four types of yogurt with different degrees of grittiness were purchased in the market.

Homemade yogurt: We prepared five types of homemade yogurt by adjusting three parameters to control the grittiness. The parameters were as follows: concentration of non-fat milk solids, protein concentration, and proportion of casein and whey proteins.

2.2. Sensory evaluation (QDA)

Four trained panels evaluated the smoothness of samples using a 15-cm scale method. A sample was placed in the mouth and spread on the tongue. The smoothness of the sample perceived by the tongue was evaluated. Distance from the left edge to the plot on a 15-cm scale was expressed using a score of 0 (smooth) to 15 (gritty) points. The mean score of the four panels (sensory evaluation score) was used for the analysis.

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