

Comparative assessment of physical characteristics of plant-based meats and animal meat products in the Japanese market

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Objectives: Recently, with increase in the world population and middle-income group of people, there are some concerns about protein deficiency due to increased demand for meat (1,2). In addition, limited land and water resources to sustain livestock, undesirable environmental effects, and climate makes it difficult that increasing the meat production to meet future demand (3). Plant-based products that being marketing as alternative to traditional animal-foods products, plant-based products are healthier and more sustainable (4). Among the plant-based products, market of the plant-based meats have growing sales to meet growing demand for meat. However, there is many consumers that reluctant to willingly purchase plant-based meats (5). Affordability, availability, and taste are important for consumers to include the plant-based meats into their diets. Desirable functional properties of the meats are difficult to imitate with using plantbased meats components (6). There is number of food processing technology have been developed to create meat-like textures by structuring plant-based protein (7). Plant-based meat products such as hamburger patties, nuggets, meatballs have already been launched to the market, and the differences between plant-based products and animal meat products have been investigated. Meanwhile, there is not much research on the tissue structure of plant-based meats which is imitation meat. The purpose of this study was to discover directions for the development of plant-based meats made from soybeans. We investigated the differences of the textures between imitated animal meat which is kind of the plant-based meats and processed animal meat products in the Japanese market.

Materials and Methods: In this study, a fillet-type, a block-type, and a imitated-chicken type plant-based meats were used as sample. Hamburger patties, Japanese fried chickens, chicken nuggets, and steamed chickens were pursued as control of processed animal meat products. Plant-based meats were in dry state, so first of all these meats were rehydrated. The steamed chickens were refrigerated (stored under 10°C), but the other animal meat products were frozen (stored at -18°C). Those frozen samples were left in refrigerator overnight to thaw, and then microwaved according to the respective cooking methods. Instrumental texture profiles and shear force test of the samples were obtained using a creep meter (RE2-33005, Yamaden, Japan). For the texture profiles test, the samples were formed into 10 mm wide×10 mm long×10 mm thick and after that compressed with a cylindrical plunger (16 mm diameter) was used. For the shear force test, the samples were formed into 10 mm wide×30 mm long×10 mm thick and a sheared with wedge shaped plunger. Both measurements were performed at room temperature.

Results and Discussion: In shear measurements, the shear stress and shear strain of the three types of plant-based meats were significantly higher than any other animal meat product, which is considered that the plunger could not shear the fibers of the plant-based meats well. The hardness of texture measurement indicates the hardness of the actual chewing sense in the oral cavity. In instrumental texture profiles test, both fillet-type and a block-type plant-based meats were significantly harder than any other animal meat products, while the imitated-chicken type had a similar hardness with the steamed chicken. We thought that the texture of the imitated-chicken type plant-based meats should be modified to be more easily sheared in order to bring the texture of the imitated-chicken type plant-based meats closer to the real chicken product. Fillettype and block-type plant-based meats should also be made easier to shear and softer in texture. In this investigation, only processed animal meat products were compared. Next time, we would like to compare with various animal meat products. In addition, in this study the comparison was based on mechanical values, but also it is necessary to correlate these values with sensory evaluation.

References:

1. Popkin, B.M., Adair, L.S., Ng, S.W. 2012. Global nutrition transition and the pandemic of obesity in developing countries, *Nutrition Reviews*, 70: 3-21.
2. FAO, 2006. "World agriculture towards 2030/2050".
3. Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., & de Haan, C. 2006. Livestock's long shadow: environmental issues and options. *Food and Agriculture Organization of the United Nations*.
4. Nelson, M. E., Hamm, M. W., Frank B Hu, F. B., Abrams, S.A, Griffin, T.S. 2016. Alignment of Healthy Dietary Patterns and Environmental Sustainability: A Systematic Review, *Advances in Nutrition*, 7: 1005-1025.
5. Slade, P. 2018. If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers, *Appetite*, 125: 428-437.
6. McClements, D.J., Weiss, J., Kinchla, A.J., Nolden, A.A., Grossmann, L. 2021. Methods for Testing the Quality Attributes of Plant-Based Foods: Meat- and Processed-Meat Analogs. *Foods*, 10: 260.
7. Gibney, M.J. 2021. Food Technology and Plant-Based Diets, *The Journal of Nutrition*, 151: 1-2.

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