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EZ Test – Plant-Based Food – Texture Evaluation

Texture Evaluation Of Plant-Based Meat Using EZ Test Analyzer Equipped With Multi-Piercing Jig

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Abstract

Plant-based meat, made from vegetables or vegan ingredients, is emerging as a sustainable solution in the face of climate change and food security concerns. To create convincing meat alternatives and increase consumers' acceptance of plant-based meat, it is crucial to have appealing texture and sensory qualities. This is where a texture analyzer plays a pivotal role, as it delivers quantitative and objective results to enable data-driven food development.

In this Technology Brief, learn how the texture analyzer EZ Test, together with a multi-piercing jig, can evaluate samples containing small food fragments of varying shapes and sizes such as flakes and cookie pieces. Using the EZ Test, measurement errors due to irregular shapes and sizes can be minimized, leading to reliable and consistent results.

Texture evaluation of tuna flakes using EZ Test

Keywords:
EZ Test, Texture Analysis, Plant-Based Meat, Textured Vegetable Protein (TVP)

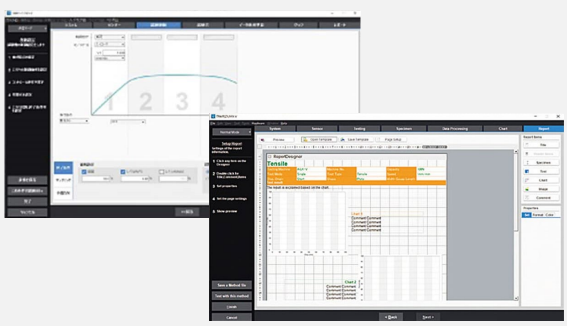
Highlights

- *Texture evaluation using the EZ Test to provide quantitative and objective results with better reproducibility.*
- *Intuitive analysis of different plant-based tuna flakes using TRAPEZIUMX-V texture mode software to determine their firmness and energy.*
- *Provides in-depth insights for food researchers and manufacturers to formulate convincing meat alternatives with appealing sensory experiences.*

Technologies Featured

EZ-X With Multi-piercing Jig

TRAPEZIUMX-V



1. INTRODUCTION

Global food shortages and food security concerns continue to exacerbate, caused by compounding factors such as climate change, rapid population growth, global food supply chain disruption and more. To enhance the resilience of global food system, new foods and novel ways of producing foods are currently being explored.

One promising solution is plant-based meat, which is a meat alternative made from vegetables or vegan ingredients. In fact, Life Cycle Assessment (LCA) studies have shown that a plant-based burger patty made with soy protein can help to reduce greenhouse gas (GHG) emissions by 98% compared to a beef burger patty[1].

In the effort to encourage market adoption of plant-based meat, it needs to be not only safe but also have an appealing texture and sensory experience that is comparable to conventional meat. Generally, there are two common methods for evaluating food texture: (1) Sensory evaluation by humans and (2) Mechanical properties evaluation by a texture analyzer. Sensory evaluation by humans is a qualitative method that can be difficult to reproduce due to individual differences in human senses and the physical condition of the subjects. Therefore, mechanical properties evaluation by a texture analyzer is preferred since it provides quantitative and objective results with better reproducibility.

In this Technology Brief, texture evaluation was conducted on commercial and plant-based tuna flakes using an EZ Test equipped with a multi-piercing jig. Thereafter, firmness (a measure of food resistance to deformation) and energy were measured and compared to determine the convincingness of the meat alternative.

2. EXPERIMENT

2.1 Sample Preparation

Three types of tuna flakes were purchased from the local market (Sample A, B, and C as per elaborated below):

- Sample A: Conventional Tuna Flakes from Brand A
- Sample B: Plant-Based Tuna Flakes from Brand B
- Sample C: Plant-Based Tuna Flakes from Brand C

A fixed amount of tuna flakes samples were weighed (50g) and placed in a metal sample cup with a base diameter of 45 mm.

2.2 Analytical Setup and Experimental Conditions

Using the EZ Test Texture Analyzer, the samples were pierced by the multi-piercing jig to stroke-strain of 75% at the speed of 50 mm/min. Three individual tests were performed, and the average was then calculated for each sample.

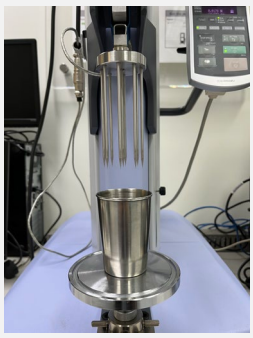
The multi-piercing jig consists of 9 penetration probes, each with a sharp tip of 3mm diameter angled at 15°. Since tuna flakes come in different shapes and sizes, a multi-piercing jig with multiple penetration probes was used to obtain average texture properties across various points.

This multi-piercing jig is ideal for analyzing the texture of non-homogeneous samples containing small food fragments of varying sizes (such as cereal, crisps, and flakes) or when air bubbles are dispersed throughout the sample (such as jam with fruit pieces or ice cream with cookie pieces etc).

Table 1: Testing Machine Configuration and Conditions

Testing Machine	EZ Test Texture Analyzer – EZ-X
Load Cell	500 N
Fixture	Multi-Piercing Jig and Lower Compression Plate
Software	TRAPEZIUMX-V
Number of Tuna Flakes Sample	n = 3
Number of Test per Sample	n = 3
Test Speed	50 mm/min
Sample size	50 g

Figure 1: Texture Experiment Set Up



3. RESULTS AND DISCUSSION

3.1. Data Analysis For Texture Evaluation

Prior to instrumental analysis, a sensory evaluation was conducted to compare the texture of conventional tuna flakes and plant-based tuna flakes. It was found that the plant-based tuna flakes had a softer texture.

Using TRAPEZIUMX-V Texture Mode Software, the firmness and energy (force and energy required for 75% stroke-strain deformation) were measured and compared. The results are tabulated in Table 2.

Table 2: Test Results (Average Values)

Sample	Firmness (N)	Energy (mJ)
Sample A	8.34	79.45
Sample B	4.36	34.09
Sample C	4.62	43.99

Figure 2 shows the Force vs Stroke-Strain averaged curve for all three samples. From the results, conventional sample A has a higher firmness value (force required for deformation) compared to both plant-based samples B and C. Similarly, in terms of the work done or energy required for deformation, conventional sample A required higher energy as compared with plant-based samples B and C. Both firmness and energy results are consistent with the sensory evaluation.

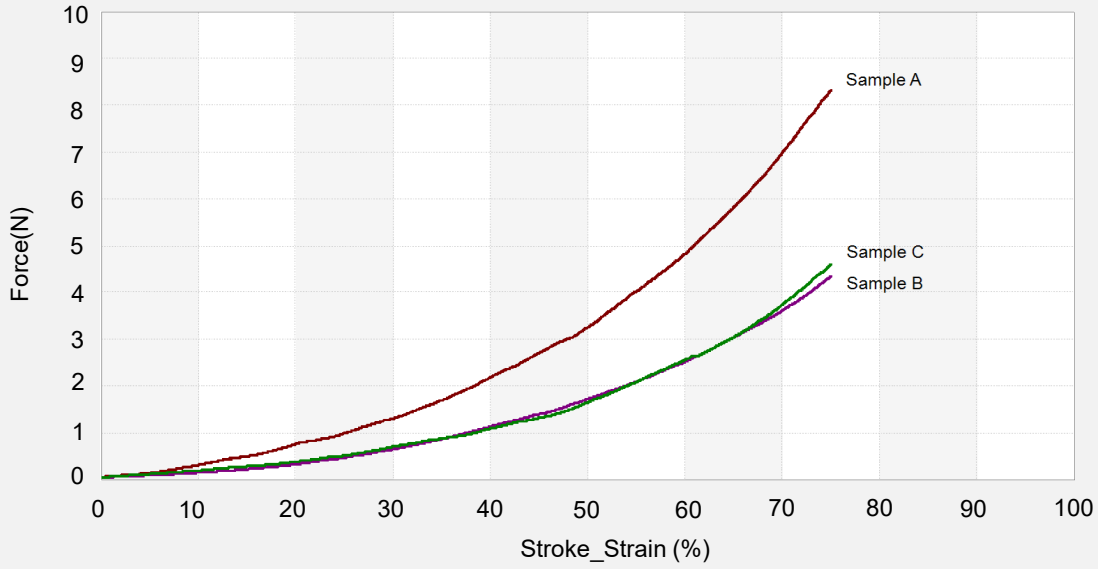


Figure 2: Force vs Stroke-Strain Curve for Three Samples of Tuna Flakes (Average Curve per Sample [n =3)]

4. CONCLUSION

The texture of two types of plant-based tuna flakes was evaluated and compared to conventional tuna flakes using Shimadzu's EZ Test texture analyzer. The firmness and energy of both types were analyzed to understand how closely plant-based meat can replicate the sensory experience of conventional meat.

This study provides a useful example of how to conduct texture evaluation in a quantitative and objective manner to compare the sensory experience of conventional meat and plant-based meat, especially for food produced in irregular shapes and sizes. By using a texture analyzer with suitable test jigs, data-driven insights can be derived for effective food development towards high quality meat alternatives.

5. REFERENCE

[1] Saerens, et al. "Life cycle assessment of burger patties produced with extruded meat substitutes." (2021).

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Creating Culinary Science

Lightweight, compact, and easy to use, Shimadzu's EZ Test is a high-precision testing system that evaluates food texture based on hardness, adhesiveness, cohesiveness, brittleness, elasticity quality, gumminess, and chewiness. By offering objective and quantifiable results, the EZ Test overcomes the challenge of poor repeatability posed by human sensory testing. In this brochure, discover how the EZ Test can be used to evaluate our day-to-day foods, including noodles, fruits, butter, and even liquids.

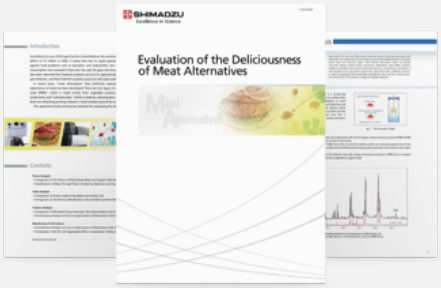
Learn More

Application Insight: Total Quality Evaluation of Plant-based Meat

As the demand for plant-based meat alternatives increases, there is a growing expectation for these alternatives to taste, smell, and feel like actual meat. In this application, discover how Liquid Chromatography Mass Spectrometry (LC-MS) and Gas Chromatography Mass Spectrometry (GC-MS) are used to evaluate hydrophilic metabolites and volatile compounds related to taste, respectively, to gain insights into the components influencing taste and aroma. Texture assessment using the EZ Test is also carried out to enhance its appeal to consumers seeking convincing meat alternatives.

Learn More

Evaluation of the Deliciousness of Meat Alternatives



In the last 50 years, the consumption of meat has increased by five-fold, contributing to nearly 20% of global greenhouse gas emissions. To address this environmental challenge, meat alternatives such as plant-based meats and cultured meats have gained momentum in global food markets. This application book summarizes the various methods for evaluating the taste of these innovative meat alternatives, paving the way for a more sustainable and environmentally conscious approach to food consumption.

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