# TEXTURE PROFILE ANALYSIS IN COOKED BURGER AS IT IS OR AFTER HOMOGENISATION WITH THE BACK EXTRUSION TEST

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## I. INTRODUCTION

Texture holds significant importance in the realm of meat and meat analogues, and it is considered a crucial quality attribute of focus for producers and researchers. As a result, many studies seek to emphasise instrumental methods that can serve as alternatives or complementary techniques to sensory evaluation. Within the framework of the EitFood project "Improving juiciness of plant-based meat alternatives," the aim of this study is to compare the instrumental texture properties of cooked meat and plant-based burgers using two distinct methods: Texture Profile Analysis (TPA) and Back Extrusion test on homogenised samples (TPAH) [1]. The specific aim is to evaluate the effectiveness and applicability of TPAH in assessing the texture attributes of burgers which proves useful for products that pose challenges during sample preparation and handling, such as plant-based burgers.

## II. MATERIALS AND METHODS

Eight batches of burgers were used, divided as follows: one commercial plant-based burgers (PBB) purchased from the market (CB); six different self-produced PBBs (P1, … P6) and one self-produced meat burgers (MB; 60 % beef, 40 % pork). Measurements were done on the cooked samples. The traditional texture profile analysis (TPA) was carried out following the standard protocol. The burgers were cooked on a grill for one minute on each side, then wrapped in foil, and steamed for 12 minutes (200 °C /80 % moisture). The temperature of the burger during the TPA measurement was set at 50 °C. A total number of 16 burgers, equal to two burgers of each type, were used. Since each burger type originated from the same batch, each burger was divided into three parts, for a total of 48 samples, which were then measured. Samples subjected to Back Extrusion Test were 48 burgers, equally divided by the 8 batches and used in the context of a wider experimental protocol for the analysis of the water content. After cooking [2] until 72 °C, reached in the core of the product, sample was homogenised in a mixer (Moulinette 800W; 600 rpm) for 20 s and poured into a commercial plastic container of 16 mL volume. During the measurement, the container was securely fixed to the base of the texturometer (Instron 5543) to prevent any movement. The TPAH was performed by applying a double uniaxial compression and the standardized experimental conditions were as follows: compression with a stainless-steel probe with a diameter of 11.2 mm at 50 % of the sample height without a delay between the first and the second compressions; the crosshead speed was 200 mm/min. The six measured parameters were: hardness, cohesiveness, springiness, gumminess, chewiness, and resilience force. Some procedures in SAS 9.4 such as Simple Correlation, Canonical Correlation Analysis and GLM were utilised. The significance of the results was evaluated using Pearson, Tukey, and Wilks' Lambda tests.

## III. RESULTS AND DISCUSSION

Except for the springiness all the parameters, measured using the two methods, appear to vary in the same manner (Table 1) as they are positively and significantly correlated, despite having different values. This outcome is expected since the two methods evaluate the burgers in different physical states (solid and semi-solid). The different physical states affect springiness differently, resulting in significant negative correlation (r = -0.72). Some of the measured parameters (hardness, chewiness) have been linked to corresponding sensory attributes. However, no correlations were found between cohesiveness and springiness [3]. All the parameters showed a high variability, which can be attributed to the different types of burgers, meat, and vegan products. For example, the hardness varies from 29.6 to 5.0 N for meat and CB, respectively, measured with the TPAH method; the same parameter varies from 32.6 to 17.4 N with the TPA method.

Table 1. Average values (mean±SD) and Pearson correlation coefficients (r) between the parameters measured using the two methods TPA and TPAH (n=48).

| Parameter | | TPA | TPAH | r | P |
|---|---|---|---|---|---|
| Hardness | N | 20.3±5.59 | 11.9±7.81 | 0.77 | <0.0001 |
| Cohesiveness | Ratio | 0.73±0.023 | 0.54±0.076 | - | NS |
| Springiness | Ratio | 0.78±0.036 | 0.87±0.071 | -0.72 | <0.0001 |
| Gumminess | N | 14.8±4.57 | 6.55±4.57 | 0.79 | <0.0001 |
| Chewiness | N | 11.6±4.14 | 5.45±3.044 | 0.73 | <0.0001 |
| Resilience force | Ratio | 0.43±0.036 | 0.87±0.021 | 0.39 | 0.0057 |

According to Ismail *et al.* [4], the higher hardness of meat burgers is due to the muscle protein denaturation phenomenon, which is also a consequence of the higher degree of shrinkage. It is interesting to note that the homogenisation does not eliminate the effect of the denaturation in meat on hardness (TPA = 32.6 N vs TPAH = 29.6 N), while on PBB there is a strong reduction in hardness (TPA = 18.5 N vs TPAH = 9.3 N). Homogenisation reduces the hardness measured with TPAH by 9% for meat while for PBBs it drops by 50%, compared to TPA. Gumminess also shows the same trend by 33% for meat while for PBBs it drops by 62% after homogenisation. The multivariate correlation between the two methods shows an Adjusted Canonical Correlation for the first canonical variables of r = 0.97, which is much larger than any other simple correlation (gumminess, r = 0.79). Results of the TPA and TPAH on cooked samples are significantly correlated even when the structure is different (solid and homogenised). Furthermore, the TPAH method also shows that it can also discriminate between different types of burgers such as the classic TPA.

## IV. CONCLUSION

The results of this study indicate that the homogenisation of the samples does not eliminate the distinctions between the various types of burgers, enabling their differentiation. To some extent, it becomes feasible to assess the sensations conveyed to consumers during the process of chewing and consuming a product. Additionally, this approach proves useful for analysing products that, due to their inherent characteristics, are unsuitable for conventional TPA methods.


## ACKNOWLEDGEMENTS

Research funded by EIT FOOD project “Improving juiciness of plant-based meat alternatives”, 2021-2022.


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