# PHYSICOCHEMICAL CHARACTERISTICS OF MICROWAVE COOKED BEEF COLD CUT AND PLANT-BASED MEAT ANALOGUE

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## I. INTRODUCTION

As the global population and meat demand continue to increase, problems such as environmental and animal welfare concerns are emerging [1, 2]. To address these problems, plant-based meat analogues are being produced as substitutes for real meat [3]. Among many cooking methods that affect meat characteristics, microwave (MW) cooking is popular due to its convenience and ability to retain the original food characteristics [4]. The objective of this study was to evaluate the physicochemical and textural properties of beef cold cut (BC) and plant-based cold cut analogue (PC) cooked by MW.

## II. MATERIALS AND METHODS

The BC (n=25) and PC (n=25) used in this study were separately supplied by Johncook and Shinsegae Food Co. MW was applied to the BC and PC for 15 seconds until the internal temperature reached 75°C. The proximate composition, pH, cooking loss, color, shear force and texture profile analysis (TPA) of the samples were determined using the method of Bakhsh et al. (2021) [3]. The microstructure of the samples before MW was measured using a scanning electron microscope (SEM). Sensory evaluation was carried out based on color, aroma, taste, tenderness, juiciness, overall acceptability (rated on a scale of 1 to 9, with 1 being very bad and 9 being very good), and off-flavor (rated on a scale of 1 to 9, with 1 being very intense and 9 being very weak) by 15 students from Kangwon National University. The data was analysed using SAS software (version 9.4, SAS Institute Inc., Cray, NC, USA) with one-way analysis of variance and Tukey's test.

## III. RESULTS AND DISCUSSION

Significant differences were found in the moisture (56.97% and 78.30%), crude protein (15.85% and 4.72%), crude lipid (19.59% and 2.94%), carbohydrate (5.70% and 10.71%), and crude ash (1.89% and 3.32%) between BC and PC, separately, before MW ($P<0.05$). After MW, BC (3.60%) had a lower cooking loss than PC (4.60%) ($P<0.05$). Bakhsh et al. (2021) suggested that methylcellulose in plant-based meat analogues was destroyed, and water was reduced after heating, and the internal structure of beef product may be more effective in retaining water than plant-based meat analogue [1]. The pH, color, shear force, and TPA of BC and PC by MW are shown in Table 1. BC had a lower pH value than PC ($P<0.05$). The result might be due to postmortem processes that produce lactic acid during the conversion of muscle to meat, and the alkaline property of TVP [3, 5]. BC had a higher a* value and lower L* and b* value than PC ($P<0.05$). The result of L* and b* value might be attributed to the original light and yellow color of isolated soy protein used in PC [2]. BC had a higher shear force and TPA value than PC ($P<0.05$). The result might be due to the microstructure of PC, which had more air cells and thinner walls than BC (Figure 1). In BC, gumminess, chewiness, and cohesiveness increased, while in PC, hardness decreased, and springiness increased after MW ($P<0.05$). The result might be that MW could make meat tough due to collagen dissolution, moisture loss, and myofibrillar protein denaturation [6] and that it generates gelatinization, a compact gluten network, and a soft characteristic in plant-based foods [4]. According to the sensory analysis results (Figure 1), BC had higher tenderness and lower juiciness than PC ($P<0.05$). The result might be due to the porous structural characteristic and high moisture content of PC.

Table 1. The pH, color, shear force and TPA of cold cut and cold cut analogue by microwave

| Parameters | Beef cold cut | | Plant-based cold cut | | SEM | P-value |
|---|---|---|---|---|---|---|
| | Before MW | MW | Before MW | MW | | |
| pH | 6.33$^{c}$ | 6.33$^{c}$ | 6.76$^{a}$ | 6.71$^{b}$ | 0.00 | <.0001 |
| L* | 57.45$^{b}$ | 54.84$^{c}$ | 68.33$^{a}$ | 67.87$^{a}$ | 0.36 | <.0001 |
| a* | 17.37$^{b}$ | 18.56$^{a}$ | 10.82$^{c}$ | 10.93$^{c}$ | 0.27 | <.0001 |
| b* | 11.11$^{b}$ | 11.36$^{b}$ | 16.25$^{a}$ | 16.38$^{a}$ | 0.20 | <.0001 |
| Shear force (N) | 11.68$^{a}$ | 11.89$^{a}$ | 4.74$^{b}$ | 4.80$^{b}$ | 0.20 | <.0001 |
| Hardness (N) | 106.13$^{a}$ | 103.40$^{a}$ | 40.17$^{b}$ | 32.10$^{c}$ | 1.79 | <.0001 |
| Springiness | 0.93$^{a}$ | 0.85$^{a}$ | 0.33$^{c}$ | 0.48$^{b}$ | 0.02 | <.0001 |
| Gumminess (N) | 23.52$^{b}$ | 40.08$^{a}$ | 4.67$^{c}$ | 3.36$^{c}$ | 1.36 | <.0001 |
| Chewiness (N) | 19.97$^{b}$ | 36.44$^{a}$ | 1.60$^{c}$ | 1.62$^{c}$ | 1.37 | <.0001 |
| Cohesiveness | 0.21$^{b}$ | 0.38$^{a}$ | 0.12$^{c}$ | 0.10$^{c}$ | 0.02 | <.0001 |

$^{a-c}$ Means within a row with different superscript differ significantly at P<0.05.

MW, Microwave cooking; SEM, standard error of the mean.

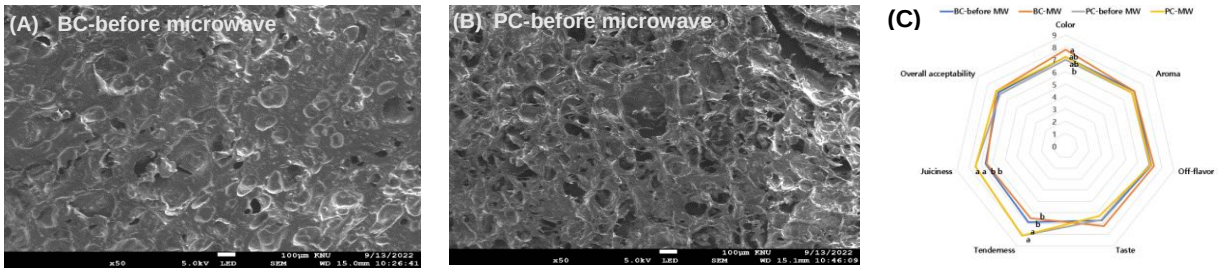


Figure 1. SEM and radar chart of sensory analysis of beef cold cut (BC) and plant-based cold cut (PC).

## IV. CONCLUSION

The physicochemical and textural properties of BC and PC differ significantly due to differences in materials. Microwave cooking also altered the textural properties of BC and PC. However, sensory analysis indicated that panellists did not perceive significant differences in any of the characteristics both BC and PC, regardless of whether they were cooked or not by MW.

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