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THE IMPACT OF TEXTURED PEA PROTEIN ON THE COLOR PROPERTIES OF HYBRID MINCED MEAT PRODUCTS

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I. INTRODUCTION

Traditional Balkan minced meat product “Ćevap” is known for its wide use and it is appreciated for its taste. This Balkan dish is typically made from minced beef or a mixture of beef and pork, and belongs to the category of minced meat heat treated by grilling before consumption. It is formed into small, skinless sausages and grilled, making it a cooked meat product. However it is often associated with high salt and saturated fatty acid content, which can lead to negative health effects. To address this, hybrid meat products offer a promising solution for healthier alternatives. These products are becoming increasingly popular nowadays, due to improved nutritional composition, environmental sustainability, and low cost [1]. The main non-meat ingredient used in hybrid products is textured vegetable protein (TVP), as it meets consumer demands for high-quality food with reduced fat content and the need for functional and nutritionally valuable food [2]. Pea protein is one of promising options for partially replacing meat in these products, primarily due to its availability and nutritional value and it has successfully used in various food products [3]. Color is the first characteristic consumers notice in minced meat products, playing a crucial role in sensory perception and overall acceptability. This study aims to assess the impact of adding textured pea protein (TPP) to minced meat product – “Ćevap”, examining its effects on color properties.

II. MATERIALS AND METHODS

The experiment included two different treatments and was conducted in two replications on different day. Each group consisted of six replicates, and three color measurements were taken per replicate, resulting in a total of 18 observations per group. Control treatment (CON) was prepared from beef (31.43%), pork (31.43%), back fat – BF (17.14%), water (8.10%), meat emulsion (4.76%), fresh onion (4.76%), salt (1.43%), sodium bicarbonate (0.48%), and dextrose (0.48%). The experimental treatment (TPP40) was designed as a control with 40% of the meat replaced with textured pea protein. Preparation of minced meat products – “Ćevap” were performed as previously described in Stajić et al [4]. The “Ćevap” samples were shaped into uniform portions (approximately 20 g each) and grilled on an electric grill at 200 °C for 8 minutes (4 per side) to ensure even cooking before image analysis. Textured pea protein (TPP) (Fratelli Pagani S.p.A., Milan, Italy) was hydrated with warm water (70-80°C) in 1:2 ratio. The meat emulsion with the addition of bamboo fibers was used as a binding material due to the low solubility of plant-based proteins. The color of samples was determined using Computer Vision System (CVS) as described in Tomasević et al [5] by defining the values of L*, a*, b*, hue angle and chroma. Statistical analysis was performed using IBM SPSS software version 17.0. The Independent Samples t-test was used to compare two independent groups with normal distribution, as determined by Shapiro-Wilk test. The Levene’s test was used to assess the equality of variances between the groups. A level of 0.05 was used for the threshold value of significance. Results are presented as the mean ± standard deviation (SD).

III. RESULTS AND DISCUSSION

As shown in Table 1, the instrumental color analysis of “Ćevap” revealed that the addition of 40% TPP (L* 80.67±0.88; a* 9.67±0.00; b* 28.78±1.35) had a significant impact on all color parameters in the raw product, as well as on brightness (L*), redness (a*), and hue angle (h) in the grilled product. The increase in brightness (L*) is often associated with greater light reflection due to the addition of TPP, which is significantly lighter in color. Meanwhile, the significant reduction ($p<0.05$) in a* values indicates a decrease in redness, which can be the consequence of reduced myoglobin content and the effect of heating. A decrease in chroma (C), in raw products may be caused by a decrease in the amount of meat, i.e. the red color that comes from raw meat. Increased b* values indicate a more

intense yellow color, probably due to the presence of pea protein. The use of TPP in the ćevap also had an impact on the hue angle (h), causing it to increase from 18.15 to 26.25, indicating a transition toward yellow-orange, which became even more pronounced after grilling. The increase in h value indicates this change, further confirming the reduction in redness [6]. Raw ćevaps with added TPP show a district difference in color from control ΔE=10.63 compared to grilled ćevaps, with a slightly smaller but still clearly noticeable difference in color after grilling ΔE=8.70. ΔE>3 indicate color changes visible to the bared eye, as can be seen in Figure 1 [7].

Table 1 – Differences in the values of instrumental color parameters.

	CON	TPP40	CON	TPP40
	Raw		Grilled	
L*	57.17±1.88	62.72±1.73*	55.83±3.39	63.00±1.76*
a*	38.78±1.83	30.11±1.24*	14.61±1.60	12.28±1.20*
b*	13.00±0.99	15.06±0.71*	20.72±1.48	23.06±2.13
C	40.09±2.04	33.67±1.20*	25.41±1.24	26.17±1.70
h	18.51±0.63	26.25±1.26*	54.81±4.08	61.83±3.81*
ΔE		10.63±1.44		8.70±2.48

*Indicate significant differences (p<0.05) between values of control and experimental treatment.

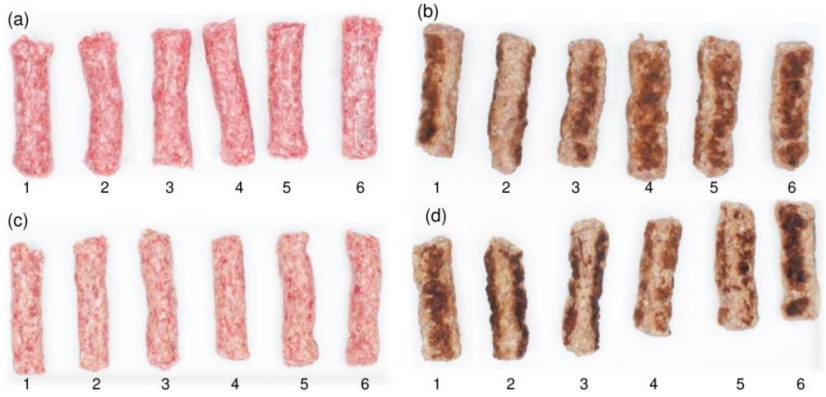


Figure 1 – Appearance of samples: (a) 1-6 CON Raw; (b) 1-6 CON Grilled; (c) 1-6 TPP40 Raw; (d) 1-6 TPP Grilled

IV. CONCLUSION

The addition of TPP to minced meat products, in this case ćevaps, resulted in a statistically significant increase in brightness (L*) and decrease in redness (a*) in both raw and grilled samples, indicating a lighter and less red product. Yellowness (b*) and hue angle (h) of both treatments increased, indicating a change in color towards yellow shades, as a result of the color of pea protein itself. Based on instrumental color analysis total color difference (ΔE) indicates a visible color change, especially in raw samples. Heat treatment, in this case grilling, further reduced the red color and increased the yellow, but these changes were less pronounced in comparison to those in raw samples. Adding pea protein significantly changes the visual appearance, which may affect the perception and acceptability of the product. Further analyses could include sensory analysis and evaluation.

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