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QUALITY CHARACTERISTICS OF LOW-FAT SAUSAGE USING CULTURED MUSHROOM MYCELIUM

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I. INTRODUCTION

Mushrooms are plant-based proteins rich in umami-flavored amino acids and have a filamentous structure that can provide a taste and texture similar to meat [1]. Mushroom mycelium is biodegradable and can be grown with little energy consumption, making it an environmentally friendly material to produce [2]. Meat substitutes produced based on this mycelium have excellent nutritional properties and meat-like flavor and texture [3]. Therefore, in this study, we focused on the possibility of grafting shiitake mushroom mycelium onto meat products and explored their potential as a sustainable protein resource.

II. MATERIALS AND METHODS

Sausages were manufactured using raw meat, pork ham (24 hours after slaughter) and cultured mycelium washed in distilled water for 24 hours. The mycelium replaced the raw meat in the ratios of 0 (C), 25 (MM25), 50 (MM50), 75 (MM75), and 100 (MM100)% and cooked at 80°C for 30 min. The samples' texture properties, sensory evaluation, electronic nose, and electronic tongue were analyzed. All results were carried out at least three times experiments, and the mean and standard deviation of the results were expressed using SAS. One-way Analysis of variance was performed, and Ducan's multiple range test was used to indicate a significant difference at the $p<0.05$ level.

III. RESULTS AND DISCUSSION

The results of the texture properties and sensory evaluation of mushroom mycelium sausages are shown in Table 1. The 75% and 100% treatment groups were excluded from the results because the shape of the sausages could not be determined and the physical properties could not be measured. As the amount of mushroom mycelium added increased, hardness, cohesiveness, gumminess, Springiness, and chewiness tended to decrease. The sensory evaluation results showed that as the amount of mushroom mycelium added increased, color, pork-flavor, and overall acceptability tended to decrease, while mushroom-flavor, tenderness, and juiciness tended to increase.

Table 1. Texture properties, Sensory evaluation of low-fat sausage using wet mushroom mycelium

Traits		Treatments[1)]				
		C (control)	MM25	MM50	MM75	MM100
Texture properties	Hardness (kgf)	2.89±0.23^{a}	1.07±0.01^{b}	0.34±0.01^{c}	ND[2)]	ND
	Cohesiveness	0.69±0.01^{a}	0.47±0.05^{b}	0.35±0.11^{b}	ND	ND
	Gumminess (kgf)	2.00±0.17^{a}	0.51±0.06^{b}	0.11±0.01^{c}	ND	ND
	Springiness	0.69±0.06^{a}	0.53±0.04^{b}	0.41±0.02^{c}	ND	ND
	Chewiness (kgf)	1.37±0.18^{a}	0.27±0.05^{b}	0.04±0.01^{c}	ND	ND
Sensory evaluation	Color	9.04±0.90^{a}	8.19±1.00^{b}	7.31±0.76^{c}	6.89±0.84^{cd}	6.40±0.64^{d}
	Pork-flavor	9.06±1.00^{a}	8.76±0.94^{a}	7.20±0.94^{b}	7.03±0.94^{b}	6.76±0.90^{b}
	Mushroom-flavor	6.47±0.62^{d}	7.22±0.68^{c}	7.90±0.79^{b}	8.79±0.89^{a}	9.39±0.92^{a}
	Tenderness	6.98±0.90^{d}	7.88±0.80^{c}	8.75±0.87^{b}	9.41±0.65^{a}	9.61±0.82^{a}
	Juiciness	6.91±0.95^{c}	7.71±0.83^{bc}	8.41±0.92^{ab}	8.82±0.84^{a}	9.35±0.90^{a}
	Overall acceptability	9.01±0.86^{a}	8.81±0.92^{a}	7.59±0.85^{b}	6.99±0.83^{bc}	6.49±0.74^{c}

All values are mean±SD.

Means in the same row with different letters (a-d) are significantly different ($p<0.05$).

[1)]C: 100% meat, MM25: replace 25% of meat with mycelium, MM50: replace 50% of meat with mycelium, MM75: replace 75% of meat with mycelium, MM100: replace 100% of meat with mycelium.

[2)]ND: not detected

Figure 2 (A) shows the intensity of the predicted volatile compounds produced in sausages according to the amount of mycelium replacement. The compound in Peak 2 is expected to be propenal, which is generally known to be

produced by lipid oxidation reactions [3]. Hexanal, expected to be the compound of Peak 6, is a product produced by the oxidation of unsaturated ω-6 fatty acids derived from animal tissues, and is used as an indicator of the freshness of meat because it causes rancidity and unpleasant odor when present in high concentrations [3], [4]. Accordingly, it is judged that the addition of mushroom mycelium tends to alleviate the unpleasant odor caused by fat oxidation of meat, thereby likely contributing to improving the flavor of sausages. Figure 2 (B) shows the results of the principal component analysis of sausages according to the amount of mycelium replacement. Salty and sour tastes tended to increase as the amount of mushroom mycelium added increased and showed the highest value in the 100% treatment group. On the other hand, umami taste increased in the order of 25, 75, 50, and 100% treatments, and showed the highest value in the control group. Edible mushrooms contain compounds such as umami amino acids (glutamic acid, aspartic acid) and 5'-nucleotides (5'-xanthosine monophosphate, etc.) [5]. Therefore, it is thought that as the amount of mycelium added increases, the content of umami amino acids also increases.

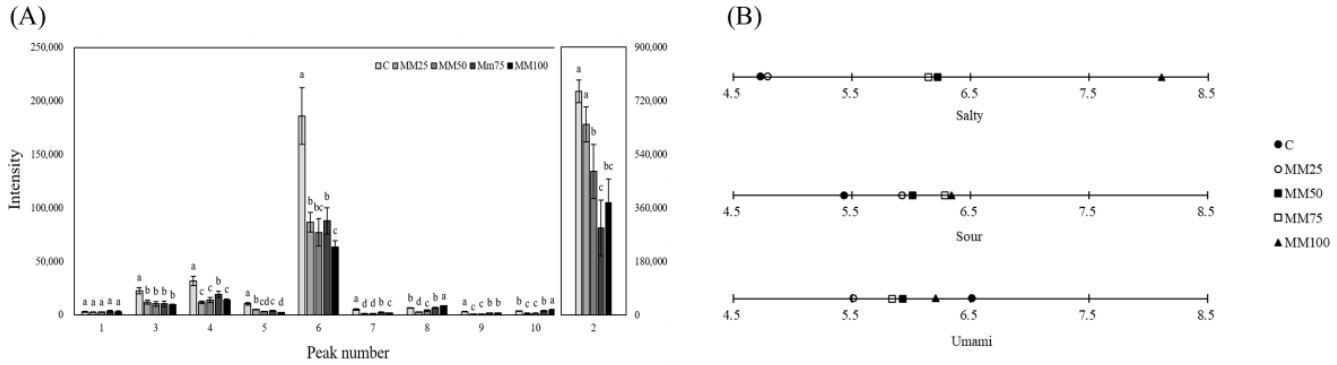


Figure 2. (A) Peak of sausage with various levels wet mushroom mycelium by electronic nose. (B) Ranking of sensory evaluation of sausages with various levels of wet mushroom mycelium by electronic tongue.

IV. CONCLUSION

In this study, the meat-tracking aspect was investigated according to the amount of added shiitake mushroom mycelium. As the amount of mushroom mycelium added increased, the texture properties generally decreased, while the tenderness and juiciness tended to increase. The electronic nose and electronic tongue analysis results showed that adding potassium mycelium tends to produce unpleasant odors due to oxidation and increases umami taste. Therefore, shiitake mushroom mycelium can contribute to improving the removal quality of products and have the potential to be used for meat-processing in the future.

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