

SCREENING OF SPECIFIC SPOILAGE ORGANISMS IN SMOKED CHICKEN LEGS WITH MODIFIED ATMOSPHERE PACKAGING AT 4 °C

Qiang Wang, Xiang-ao Li, Qian Chen and Baohua Kong*

College of Food Science, Northeast Agricultural University, Harbin, Heilongjiang 150030, China

*Corresponding author email: kongbh63@hotmail.com

I. INTRODUCTION

Modified atmosphere packaging (MAP) is a controlled aerated packaging, which not only maintains the appearance of meat products, but also inhibits the growth of bacteria to maintain quality [1]. However, the shelf-life of MAP meat products still needs to be improved. Specific spoilage organisms (SSOs) are the main microorganisms that promote the spoilage of meat products during storage [2]. Therefore, the purpose of this study was to investigate the main SSOs of MAP smoked chicken legs and lay the foundation for subsequent targeted inhibition of SSOs, shelf-life extension, and quality improvement.

II. MATERIALS AND METHODS

MAP (60% CO₂ and 40% N₂) smoked chicken legs were prepared and stored at 4 °C according to a procedure described by Wang *et al.* [3]. The pH, thiobarbituric acid reactive substances (TBARS), hardness, moisture content, colour, lactic acid bacteria (LAB) counts, total viable counts (TVC), and bacterial diversity were measured according to Wang *et al.* [3]. Data were analysed using the IBM SPSS Statistics 27 software package and the results were expressed as the mean and standard error of means (SEM). The confidence interval was set at 95% ($P < 0.05$). In addition, correlation analysis and upset map were performed and plotted using R software.

III. RESULTS AND DISCUSSION

1. Physicochemical quality

Table 1. Changes in the physicochemical properties of modified atmosphere packaging smoked chicken legs during a 25-day storage at 4 °C.

Physicochemical property	Storage time						SEM	P-value
	0 d	5 d	10 d	15 d	20 d	25 d		
pH	6.53 ^d	6.69 ^c	6.74 ^b	6.83 ^a	6.81 ^a	6.50 ^d	0.0310	< 0.01
TBARS (mg/kg)	0.355 ^e	0.453 ^{de}	0.539 ^{cd}	0.638 ^{bc}	0.746 ^b	1.04 ^a	0.0552	< 0.01
Hardness (N)	5.15 ^a	4.96 ^a	4.96 ^a	4.83 ^a	4.78 ^{ab}	4.24 ^b	0.0820	0.02
Moisture content (%)	65.3	65.6	65.3	65.8	65.5	65.6	0.0883	0.50
<i>L</i> *-value	43.3	44.0	43.2	43.9	44.1	43.2	0.118	0.06
<i>a</i> *-value	14.9 ^a	14.7 ^a	14.4 ^{ab}	14.1 ^b	13.4 ^c	13.4 ^c	0.112	< 0.01
<i>b</i> *-value	33.6 ^e	34.0 ^{de}	34.5 ^{cd}	35.0 ^c	36.3 ^b	37.5 ^a	0.207	< 0.01

^{a-e} Means within the same row with different lowercase letters differ significantly ($P < 0.05$).

As indicated in Table 1, the pH gradually increased from day 0 and reached a maximum at day 15 ($P < 0.05$), and then gradually decreased. The increase in pH may be due to the continuous formation and accumulation of ammonia and biogenic amines. The decrease in pH may be related to the increase in LAB counts. The TBARS value increased significantly throughout storage. The hardness of smoked chicken thighs decreased significantly ($P < 0.05$) at the end of storage. The moisture content and *L** value did not change significantly throughout storage. The decrease in *a** value may be caused by the interaction between pigment and lipid oxidation products [3]. The *b** value gradually increased after 20 d ($P < 0.05$), which may be due to the yellow pigments derived from the reaction between lipid oxidation products and amine from phospholipid head groups or amine from proteins.

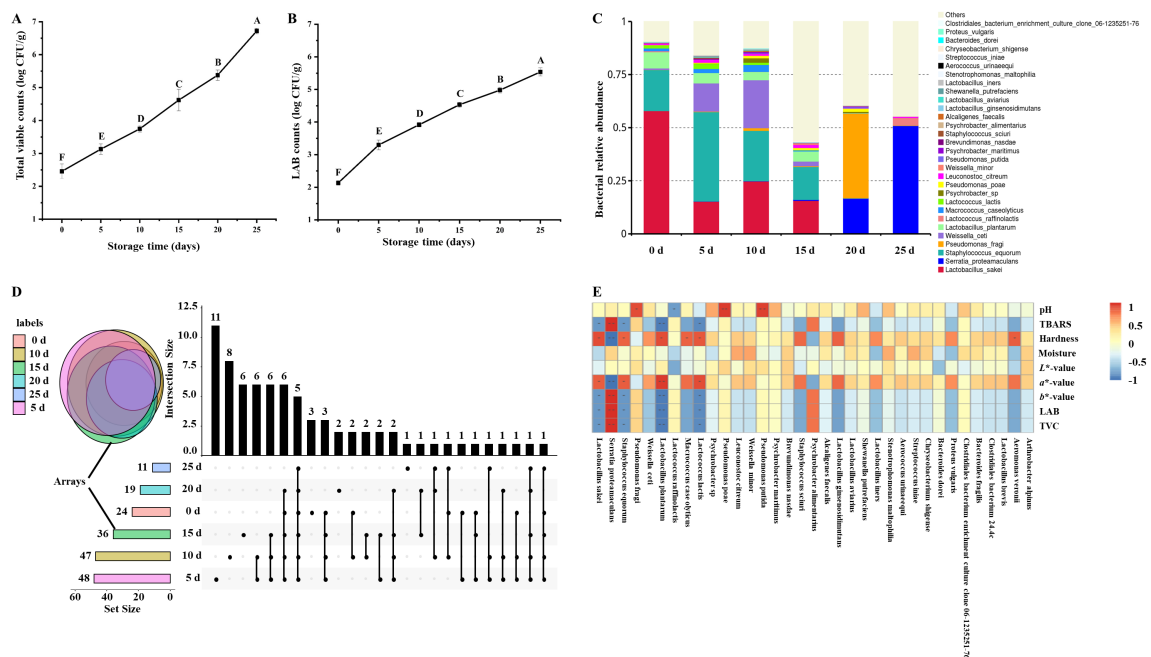


Figure 1. Bacterial succession of MAP smoked chicken legs during a 25-day storage at 4 °C: counts of total viable bacteria (A); counts of lactic acid bacteria (B); bacterial relative abundance (C); the upset figure based on species level (D). Correlations between bacterial communities and physicochemical properties (E). The different uppercase letters (A–F) indicate significant differences after different storage times ($P < 0.05$).

2. Microbiological analysis

The TVC (Fig. 1 A) and LAB counts (Fig. 1 B) gradually increase throughout storage ($P < 0.05$). A total of 76 species were identified and the main bacteria in the spoilage period were *Serratia proteamaculans*, *Pseudomonas fragi*, and *Lactococcus raffinolactis* (Fig. 1 C). *S. proteamaculans* is a frequent spoilage bacterium in MAP meat products. In Fig. 1 D, five bacteria were present throughout storage, and six bacteria were present during the first 20 d. The pH was positively correlated with the three *Pseudomonas*, which may be due to the *Pseudomonas* promoting protein degradation and amino acids to produce alkaline substances. *S. proteamaculans* was positively correlated with the TBARS and b^* value indicating that *S. proteamaculans* might promote lipid oxidation.

IV. CONCLUSION

Based on physicochemical characteristics, microbiological analysis, and the correlation between physicochemical characteristics and bacterial succession of smoked chicken legs, four bacteria, including *S. proteamaculans*, *P. fragi*, *P. putida*, and *P. poae*, were predicted to be SSOs.

ACKNOWLEDGEMENTS

Kong B. H. thanks the financial support from the by the Major Science and Technology Projects in Heilongjiang province (2020ZX07B72, 2021ZX12B05).

REFERENCES

1. Lei, Y., Zhang, Y. L., Cheng, Y. Q., Huang, J. C. & Huang, M. (2023). Monitoring and identification of spoilage-related microorganisms in braised chicken with modified atmosphere packaging during refrigerated storage. *Food Science and Human Wellness* 12: 28–34.
2. Lv, Y. C., Yin, X. Y., Wang, Y., Chen, Q. & Kong, B. H. (2020) The prediction of specific spoilage organisms in Harbin red sausage stored at room temperature by multivariate statistical analysis. *Food Control* 123: 107701.
3. Wang, Q., Chen, Q., Xu, J. H., Sun, F. D., Liu, H. T. & Kong, B. H. (2022). Effects of modified atmosphere packaging with various CO₂ concentrations on the bacterial community and shelf-life of smoked chicken Legs. *Foods* 11: 559.