71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

IMPROVING GOOSE MEAT QUALITY THROUGH ULTRASOUND-ASSISTED TENDERIZATION AND BRINING

Yi-Wen, Chen[1], Ya-Shiou Chang[1-2*]

[1] Department of Animal Science, Chinese Culture University, Taipei, Taiwan

[2] Department of Biotechnology and Animal Science, National Ilan University, Yilan County, Taiwan

*Corresponding author email: zyx21@ulive.pccu.edu.tw; yashiou@niu.edu.tw

I. INTRODUCTION

Goose meat is known for its rich flavor and high nutritional value, but its toughness poses a challenge to consumer acceptance (Wołoszyn et al., 2020). High-intensity ultrasound (HIU) treatment, followed by short-term refrigerated aging, is expected to enhance skeletal muscle cell membrane rupture, accelerate endogenous enzyme activation, and increase myofibrillar protein degradation (Misra et al., 2017). Additionally, HIU improves brine penetration, promotes the exposure of myofibrillar structures (Mason et al., 2010). When combined with brining, HIU may induce physicochemical changes in muscle proteins, further potentially improvs meat tenderness (Saleem & Ahmad, 2016). This study investigates the combined effects of ultrasound-assisted tenderization and brining on the quality of White Roman goose breast meat. HIU treatment and brining with sodium bicarbonate or calcium lactate were applied to evaluate their impact on color, meat texture, and cooking loss. The findings will contribute to the development of innovative processing methods aimed at enhancing goose meat tenderness and overall quality.

II. MATERIALS AND METHODS

White Roman goose carcasses (N = 30) were divided into three groups: a control group (vacuum-packaged without brining) and two brining treatments with 90 mM sodium bicarbonate (SB) or 30 mM calcium lactate (CL). Both sides of the breast muscles were removed within 1 hour postmortem at 12°C. For the SB and CL treatments, the breast muscles were soaked in an equal weight of pre-chilled brine at 4°C, while control samples were vacuum-packaged and ultrasonicated at 40 kHz for 60 minutes in a 4°C ice bath. After ultrasonication, the SB- and CL-treated breast muscles were removed from the brine and stored individually in zip-lock bags. The left-side breast muscle was sampled before ultrasonication (BU) and at 24 and 48 hours of storage at 5°C for external objective color and TBARS analysis (Cropp et al., 2024). The right-side breast muscle was divided into two equal parts and sampled at 24 and 48 hours postmortem for shear force analysis (Chang et al., 2019). Data were analyzed using the Mixed Model Procedure (SAS 9.3), with statistical significance set at $P < 0.05$.

III. RESULTS AND DISCUSSION

The results of this study demonstrated effects of different treatments, including ultrasonic treatment, on the color, oxidative stability, and tenderness of White Roman goose breast meat. Redness (a*) and yellowness (b*) values showed substantial differences between the control and treated groups. The control group maintained higher redness (19.22 at 48h) and lower yellowness (4.30 at 48h), while the SB and CL treatments led to reduced redness (7.01 and 6.66 at 48h) and increased yellowness (5.85 and 6.29 at 48h) over time. These changes suggest that the treatments, particularly ultrasonic treatment, influenced the oxidative processes in the goose breast meat by potentially enhancing the permeability of the meat matrix and promoting better absorption of sodium bicarbonate or calcium lactate, both of which have antioxidant potential effects during storage (Xiong, 2008). Additionally, TBARS values (mg MDA/Kg), an indicator of lipid oxidation, were significantly higher in the control group (0.63 at 48h), suggesting increased oxidative degradation, while the SB and CL treatments helped mitigate lipid oxidation (0.51 and 0.34 at 48h, respectively), potentially enhancing the meat's shelf life and quality. The shear force values (Kg) also reflected the positive effects of the treatments, with the control group exhibiting the highest shear force (7.25 at 48h), indicating tougher meat. In contrast, the SB and CL treatments resulted in lower shear force values (4.87 and 3.74 at 48h, respectively), signifying improved tenderness. The ultrasonic treatment likely enhanced the protein structure and facilitated the breakdown of muscle fibers, leading to greater tenderness (Bhat et al., 2018; Misra et al., 2017). These treatments appear to have a synergistic effect by not only reducing lipid oxidation but also improving the proteolytic processes responsible for muscle softening. The combined effect of reduced oxidation and improved tenderness, especially with the added benefit of ultrasonic treatment, makes the SB and CL treatments promising for improving the overall quality of goose breast meat, potentially leading to better consumer acceptance and extended shelf life.

Table 1. TBARS, external objective color (L = lightness, a = redness, b = yellowness), and shear force values of White Roman goose breast meat.

	CON			SB			CL				Treatment
	BU	24	48	BU	24	48	BU	24	48	SEM	P value
Lightness	45.87	46.80	45.30	44.98	44.06	44.01	43.76	45.54	46.28	0.36	0.174
Redness	15.40	18.31	19.22	8.78	7.01	6.66	9.08	6.69	5.82	1.78	<0.05
Yellowness	4.30	4.80	5.38	5.41	5.85	6.29	4.39	5.30	4.47	0.23	<0.05
TBARS (mg MDA/Kg)	0.30	0.55	0.63	0.32	0.47	0.51	0.25	0.31	0.34	0.04	<0.05

[a-c] Means with different letters within a row differ significantly (P < 0.05).
SEM = Standard error of the mean.

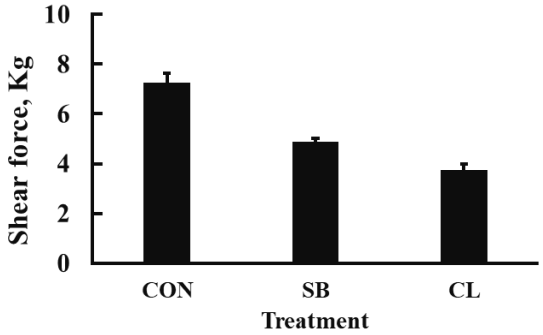


Figure 1. Shear force values (kg) of White Roman goose breast meat at 48 hours post-treatment. Each point is the average of 10 observations. Bar = standard error (SE).

IV. CONCLUSION

The combination of ultrasonic treatment and alternative brining enhances goose meat quality by improving tenderness, color, and oxidative stability. These methods support a sustainable and clean-label approach for the poultry industry. This study demonstrated that ultrasound with baking powder (sodium bicarbonate, SB) or calcium lactate (CL) improved tenderness, reduced redness, increased yellowness, and lowered TBARS values, indicating better oxidative stability and extended shelf life. The synergy between ultrasound and brining offers a promising strategy for enhancing goose meat quality.

ACKNOWLEDGEMENTS

This research was supported by a grant from the Ministry of Science and Technology (MOST 113-2313-B-034-001-), Taiwan, R. O. C..

REFERENCES

1. Chang, Y. S., Hsu, M. J., & Chou, R. G. R. (2018). Postmortem role of calpain-11 in ostrich skeletal muscle. *Meat science*, *143*, 147-152.
2. Cropp, M. S., Tarté, R., Dickson, J. S., Shaw, A. M., Houser, T. A., Prusa, K. J., & Sebranek, J. G. (2024). Nitrite-embedded film develops cured color in nitrite-free bologna sausage packaged following thermal processing. Meat and Muscle Biology, 8(1).
3. Bhat, Z. F., Morton, J. D., Mason, S. L., & Bekhit, A. E. D. A. (2018). Applied and emerging methods for meat tenderization: A comparative perspective. *Comprehensive Reviews in Food Science and Food Safety*, *17*(4), 841-859.
4. Mason, T. J., Paniwnyk, L., Chemat, F., & Vian, M. A. 2010. Ultrasonic food processing. Alternatives to Conventional Food Processing. 387-414.
5. Misra, N. N., Cullen, P. J., & Tiwari, B. K. 2017. Ultrasound processing applications in the meat industry. Emerging technologies in meat processing: Production, Processing and Technology. 149-170.
6. Saleem, R., & Ahmad, R. 2016. Effect of low frequency ultrasonication on biochemical and structural properties of chicken actomyosin. Food Chemistry. 205: 43-51.
7. Wołoszyn, J., Wereńska, M., Goluch, Z., Haraf, G., Okruszek, A., Teleszko, M., & Król, B. (2020). The selected goose meat quality traits in relation to various types of heat treatment. Poultry science, 99(12), 7214-7224.
8. Xiong, Y. L. (2012). Nonmeat ingredients and additives. *Handbook of meat and meat processing*, *2*, 573-588.