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

THE APPLICATION OF INNOVATIVE MARINADES TO BEEF AND DEER SOUS-VIDE PRODUCTS

Monika Modzelewska-Kapituła[1*], Katarzyna Tkacz[1]

[1] Department of Food Microbiology, Meat Technology and Chemistry, Faculty of Food Science, University of Warmia and Mazury in Olsztyn, Poland;

*Corresponding author email: monika.modzelewska@uwm.edu.pl

I. INTRODUCTION

The meat industry is constantly seeking possibilities to improve product' quality. One of the ways is the application of marinades to meat which opens the possibilities not only to obtain products with distinct quality properties [1] but also might result in prolonging their shelf-life. The study aimed to create innovative marinade compositions and determine their usefulness in the production of sous-vide products from beef and deer meat. The hypothesis that marinades containing ingredients less commonly used in meat processing will go well with beef and deer was tested.

II. MATERIALS AND METHODS

Five innovative marinade recipes were created based on common food products with an addition of herbs and juices being the source of bioactive compounds. The following marinades were prepared: M1 (pepper based), M2 (fermented cucumber juice based), M3 (fermented beetroot juice based), M4 (rosehip juice based) and M5 (beer based). The *semimembranosus* muscles from beef and farm deer carcasses after 14-d ageing at 4°C were used. The steaks (approx. 120 g and 2.5 cm thick) from beef and deer were marinated individually in plastic containers covered with lids, completely submerged in the marinade, at 4°C for 24h. After marinating the weights of samples were determined to calculate marinade absorption. Next, marinated steaks were vacuum-packed in plastic bags and sous-vide cooked (Sous-Vide GN 2/3, Hendi Food Equipment, the Netherlands) at 60°C for 4h. After termination of the heating, the samples were cooled, their surface dried with a paper towel and the colour (Chromameter CR-400, Konica Minolta, Osaka, Japan) and weight were determined to calculate cooking loss. The sensory analysis was conducted after reheating the steaks using the scoring method (scale from 1 – imperceptible / extremely dry, thought / not acceptable to 10 – extremely intense / extremely juicy, tender / extremely acceptable) [1] and the ranking method, where the panellists were asked to rank samples from 1 to 5 (1 – the best-rated sample, 5 – the lowest-rated sample). The effect of marinade and meat type was analyzed using the variance components analysis, whereas mean values were compared using the RIR Tuckey test.

III. RESULTS AND DISCUSSION

The marinade absorption depended on the marinade and meat types. In beef, it was noted that sample weights increased after marinating in M2 and M3 marinades (0.6% and 2%, respectively), whereas marinating in M1, M4 and M5 reduced the sample weights (0.3%, 0.2% and 3.1%, respectively). In deer meat, marinating in all marinades increased sample weights from 0.3% (M1) to 9.8% (M3). Meat samples (beef and deer) marinated in M3 showed the lowest cooking loss (22% and 14%, respectively), whereas M5 was the highest (30% and 15% respectively). Differences in the marinades' absorption were probably caused by the difference in their density and the osmotic pressure the marinades exerted. Many studies have shown that acidic marinades increase meat weight and have a positive effect on the water-holding capacity of meat. These properties are associated with increased extractability of myofibrillar proteins and swelling and are correlated with a reduction in pH values and an increase in ionic strength [2,3]. In the present study, M3 showed the lowest pH (3.19) compared with M5 (4.53).

Sous-vide products differed in colour which resulted from the colour of meat and marinades used (Table 1). Steaks marinated in M1 showed lighter colour than M3, M4 and M5 marinated meat, whereas M3 and M5 marinated samples had more red hues than M1 and M2 samples. Moreover, M2 marinated samples showed more yellow hues than remining samples.

The sensory quality of sous-vide steaks in terms of juiciness, tenderness, spices and sour taste intensity was not affected by marinade and meat type (Table 2). In contrast, spices aroma intensity was scored higher in M2 and M5 marinated steaks compared to M4 samples.

Table 1 – The influence of marinade and meat type on the colour of sous-vide products

Attribute	Marinade (M)					Meat type (MT)		Significance (p-value)		
	M1	M2	M3	M4	M5	Beef	Deer	M	MT	MxMT
L*	36.09^{a}	34.14^{ab}	27.02^{c}	30.60^{bc}	30.13^{c}	33.16	30.04	***	***	***
a*	5.23^{bc}	4.22^{c}	6.62^{a}	5.59^{ab}	6.67^{a}	5.86	5.47	***	NS	**
b*	6.03^{b}	9.95^{a}	5.08^{b}	5.61^{b}	5.78^{b}	7.15	5.83	***	***	NS
C*	8.02^{b}	10.83^{a}	8.35^{b}	7.97^{b}	8.84^{b}	9.42	8.18	***	***	
h°	48.50^{b}	66.79^{a}	37.60^{c}	44.80^{bc}	40.86^{bc}	50.18	45.24	***	***	**

$^{a-c}$ – mean values in rows with different letters differ at p<0.05; **p<0.01, ***p<0.001, NS non-significant

Table 2 – The influence of marinade and meat type on sensory quality (points from 1 to 10) of sous vide products

Attribute	Marinade (M)					Meat type (MT)		Significance (p-value)		
	M1	M2	M3	M4	M5	Beef	Deer	M	MT	MxMT
Spices aroma intensity	6.40^{ab}	8.20^{a}	7.40^{ab}	4.70^{b}	7.80^{a}	6.80	7.00	***	NS	NS
Juiciness	7.10	7.00	7.30	7.70	7.20	6.96	7.56	NS	NS	NS
Tenderness	7.40	7.00	7.10	8.80	7.80	7.36	7.88	NS	NS	NS
Spices taste intensity	6.10	7.70	7.30	5.90	6.70	7.12	6.36	NS	NS	NS
Sour taste intensity	3.50	3.90	2.70	3.10	2.60	3.36	2.96	NS	NS	NS

$^{a-b}$ – mean values in rows with different letters differ at p<0.05; ***p<0.001, NS non-significant

The rank method was used to determine which marinades were the most suitable for preparing beef and deer sous-vide products. It was found that M4, M1 and M3 marinated sous-vide steaks were ranked 1st, 2nd and 3rd place in terms of overall acceptability, resulting in lower total points than M2 and M5 samples (Figure 1).

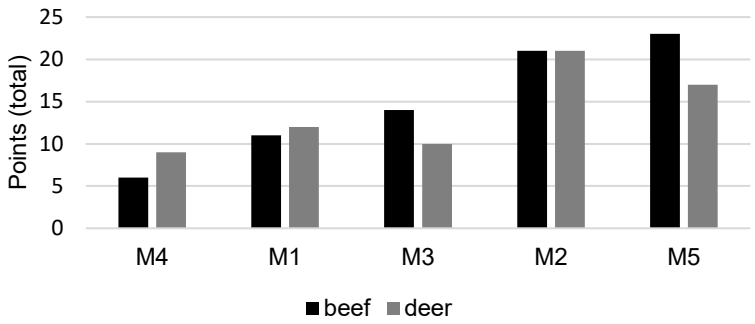


Figure 1. The ranking of marinated sous-vide meat products' acceptability (lower total points indicate higher acceptability)

IV. CONCLUSION

The quality of sous-vide meat products might be shaped using marinades. This study highlighted the role of marinade composition in cooking losses, the colour and the acceptability of products. This study was the first stage of work aiming to determine the effect of marinade composition on the quality parameters of beef and deer sous-vide products and their changes during cold storage. The results enabled us to choose the most promising marinades, which are based on rosehip juice (M4), pepper (M1), and fermented beetroot juice (M3), which will be used in further stages of the study.

ACKNOWLEDGEMENTS

The research received funding from Faculty of Food Science, University of Warmia and Mazury in Olsztyn, Poland.

REFERENCES

1. Tkacz, K.; Modzelewska-Kapituła, M.; Petracci, M.; Zduńczyk, W. (2021) Improving the quality of sous-vide beef from Holstein-Friesian bulls by different marinades. Meat Science, 182:108639.
2. Augustyńska-Prejsnar, A.; Sokołowicz, Z.; Hanus, P.; Ormian, M.; Kačániová, M. (2020) Quality and safety of marinating breast muscles of hens from organic farming after the laying period with buttermilk and whey. Animals, 10(12): 2393.
3. Nour, V. (2022) Effect of sour cherry or plum juice marinades on quality characteristics and oxidative stability of pork loin. Foods, 11(8): 1088.