

COMBINED EFFECT OF HIGH-PRESSURE PROCESSING AND STORAGE TEMPERATURE REGIME ON THE QUALITY OF BEEF TOPSIDE

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INTRODUCTION

- ❖ High-Pressure Processing (HPP) is a non-thermal technology used to improve meat safety and shelf-life.
- ❖ Temperature fluctuations during storage may reduce the effectiveness of HPP.
- ❖ Fluctuating temperatures can accelerate microbiological and physicochemical deterioration of meat products.
- ❖ The interaction between HPP and storage temperature regime may influence beef quality during chilled storage.
- ❖ **Objective:** to evaluate the combined effect of HPP and stable (4°C) or fluctuating (4–12°C) storage conditions on beef topside quality.

- ❖ Storage day significantly affected all texture parameters.
- ❖ Cohesiveness was additionally influenced by temperature and interaction effects.
- ❖ The strongest effect was observed for cohesiveness.

Table 2. Univariate Analysis of Variance (Two-Way ANOVA) results

Param.	Temp. F	Temp. p	Day F	Day p	T. × D. F	T. × D. p
Hardness	0.53	0.466	13.99	<0.001	0.48	0.620
Cohesi.	12.02	<0.001	215.12	<0.001	12.31	<0.001
Springi.	2.30	0.131	15.47	<0.001	1.19	0.307
Chewin.	0.76	0.385	13.86	<0.001	0.35	0.707

MATERIALS AND METHODS



Figure 1. Vacuum-packaged beef topside sample after HPP treatment

Storage state	Raw (chilled)
Storage temperatures	4 °C, 4–12 °C (48 h fluctuation)
Storage (sampling) days	0, 9, 14
Analyses on the samples	pH, texture (TPA), total viable count (TVC), and lactic acid bacteria (LAB)
Statistical analysis	MANOVA, UNIANOVA

RESULTS

pH

- ❖ Significant effects of storage day, temperature regime, and their interaction were observed on pH values ($p < 0.001$).
- ❖ pH remained relatively stable at 4°C, while fluctuating temperatures (4–12°C) caused a pronounced increase during storage.
- ❖ The highest pH was detected on day 14 under fluctuating storage conditions.

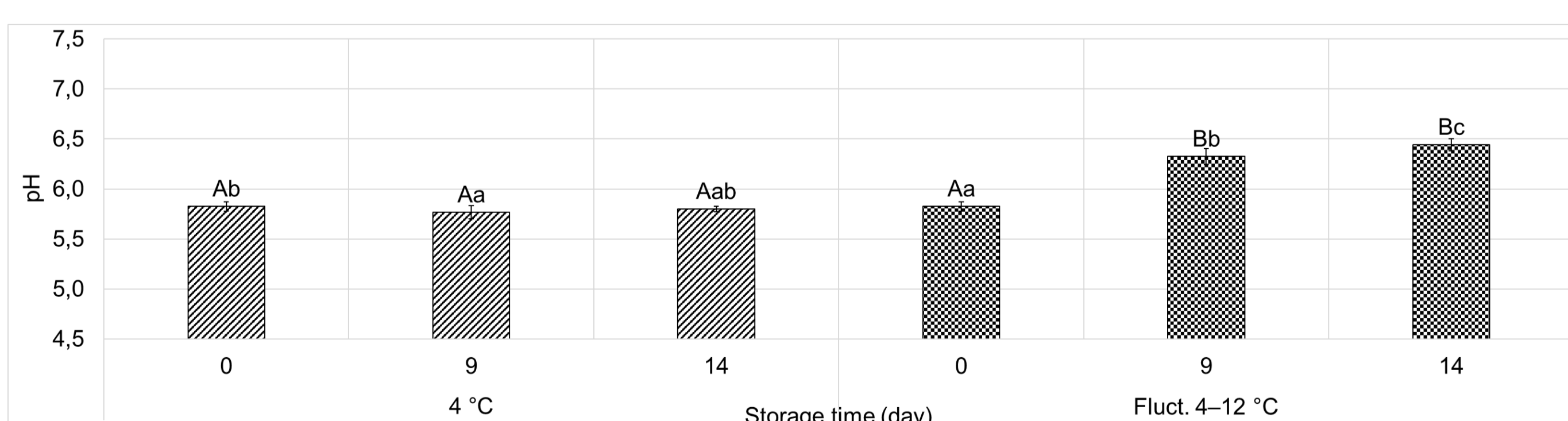


Figure 2. pH changes during storage

Lowercase letters = differences between days (Tukey), UPPERCASE letters = differences between temperatures (t-test) ($p < 0.05$).

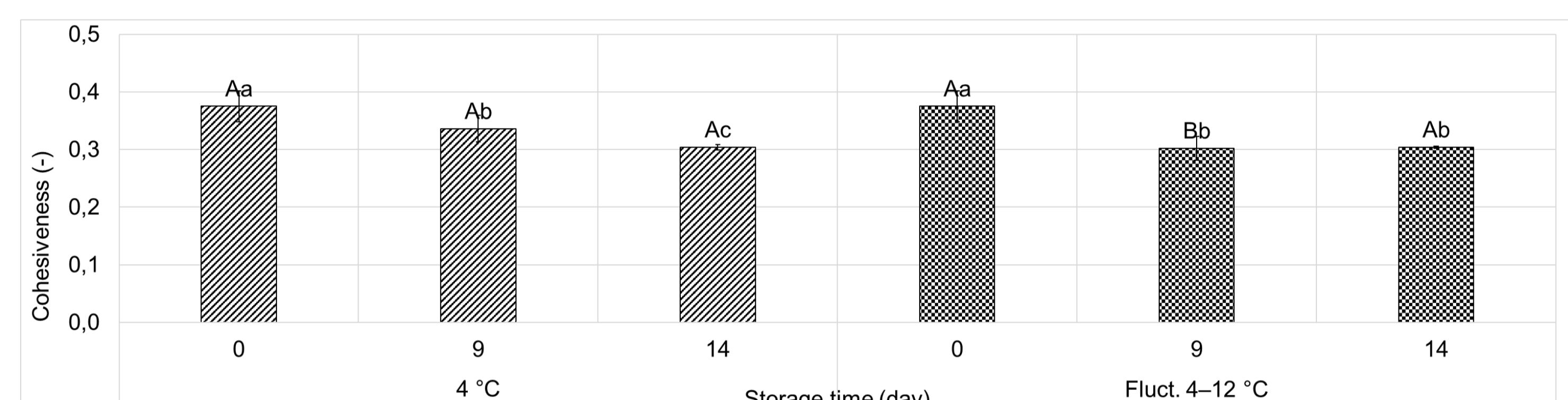
Texture Profile Analysis (TPA)

- ❖ Storage day showed the strongest effect
- ❖ Temperature and interaction effects were significant but smaller.

Table 1. MANOVA results

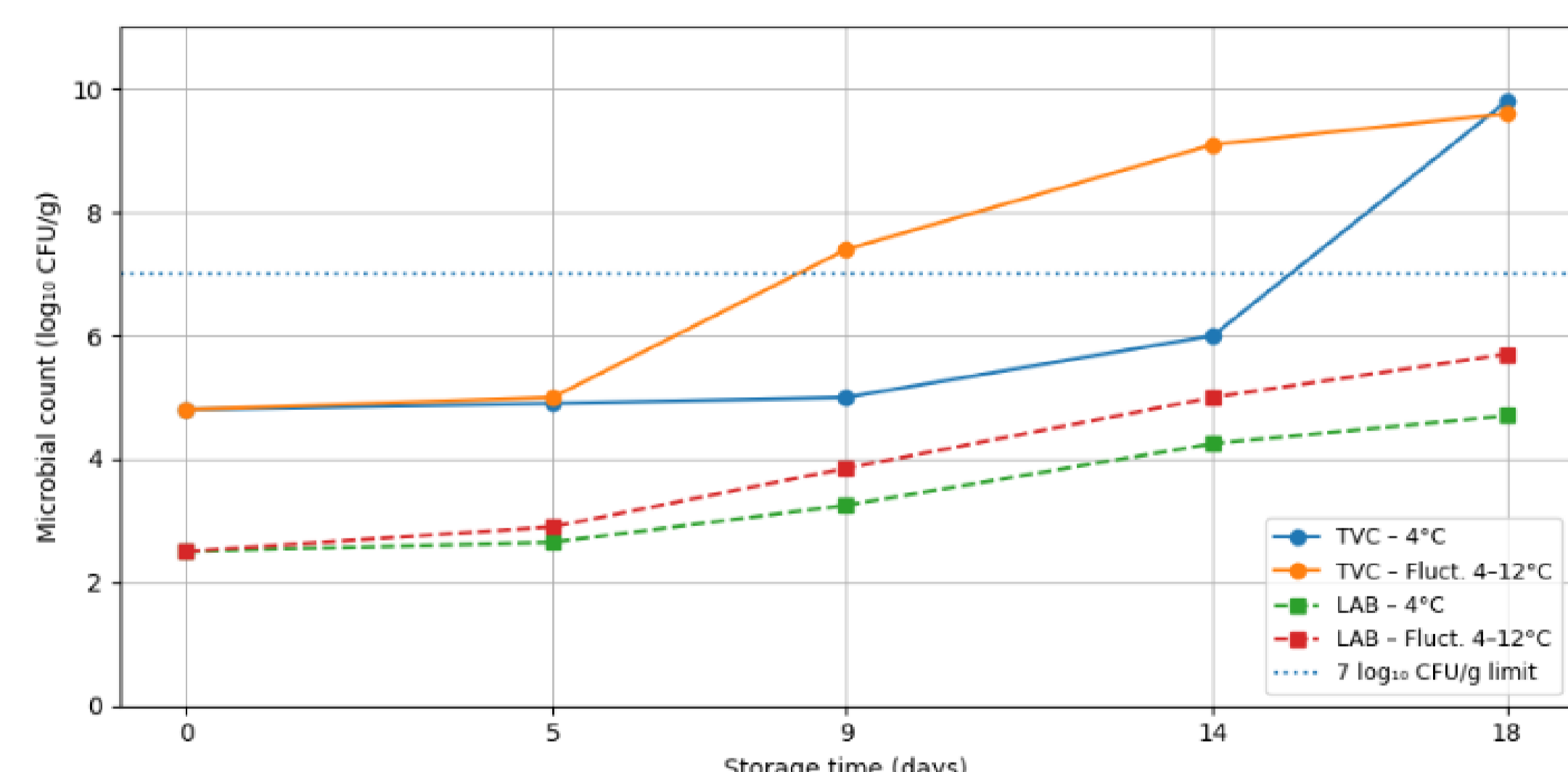
Effect	Wilks' λ	F	p-value	Partial η^2
Temperature	0.889	5.23	<0.001	0.111
Day	0.166	60.83	<0.001	0.593
Temp. × Day	0.819	4.38	<0.001	0.095

- ❖ Cohesiveness decreased during storage, indicating structural weakening of beef topside samples.
- ❖ The decrease was more pronounced under fluctuating temperature by day 9, but both regimes reached similar values by day 14.



Figures 3. Cohesiveness (-) of beef topside

- ❖ Microbial counts increased in both groups during storage.
- ❖ Fluctuating 4–12°C conditions accelerated both TVC and LAB growth compared to stable 4°C.
- ❖ The $7 \log_{10}$ CFU/g TVC limit was exceeded earlier under fluctuating storage.



Figures 4. Microbial Growth in HPP-Treated Beef Topside

CONCLUSION

- ❖ pH increased more strongly under fluctuating 4–12°C storage, indicating faster physicochemical deterioration.
- ❖ Texture changes, especially decreasing cohesiveness and hardness, suggested progressive structural weakening during storage.
- ❖ TVC and LAB counts increased faster under fluctuating temperature, showing that stable 4°C storage better maintained the quality of HPP-treated beef topside.

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