INFLUENCE OF ULTIMATE PH AND FREEZING STORAGE TIME ON THE QUALITY OF *LONGISSIMUS LUMBORUM* STEAKS FROM NELORE (*BOS INDICUS*) CATTLE

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I. INTRODUCTION

Beef is a highly perishable product and in recent decades research has been conducted on the implementation of strategies to extend its shelf life [1], including the use of low temperatures. In industry, freezing is an important technique used to extend shelf life and allow products to be supplied and marketed to various regions of the world in a safe way [2]. The final pH of meat has a great influence on the quality parameters [3]. Therefore, this study aimed to evaluate the effect of freezing and ultimate pH [pH_u, Normal (≤ 5.79), Intermediate (5.80 to 6.19) and High (≥ 6.20)] on the colour stability, water loss, lipid and protein oxidation of *Longissimus lumborum* muscles from non-castrated male Nellore cattle.

II. MATERIALS AND METHODS

In the slaughterhouse, 24 cattle were slaughtered, and eight *Longissimus lumborum* muscles were selected for each pH_u range [pH_u, normal (≤ 5.79), intermediate (5.80 to 6.19) and high (≥ 6.20)]. The meat was matured for 14 days and then stored at -20°C for 3, 6, 9, and 12 months. Instrumental colour (*L**, *a**, *b**), thawing loss and lipid and protein oxidation were evaluated after each freezing period. The results obtained were analysed using RStudio 3.6.1 software. ANOVA and Tukey grouping were also analysed and considered statistically different when $P<0.05$.

III. RESULTS AND DISCUSSION

Freezing resulted in a higher percentage of thawing loss in meat ($P<0.05$) and meat with normal pH_u showed greater amounts of loss than samples with intermediate and high pH_u (Figure 1). Additionally, freezing for longer periods resulted in greater loss of water during thawing for meat frozen for 9 and 12 months compared to meat frozen for 3 and 6 months. This is possibly due to larger intercellular ice crystals forming during slow freezing, leading to more structural damage [4].

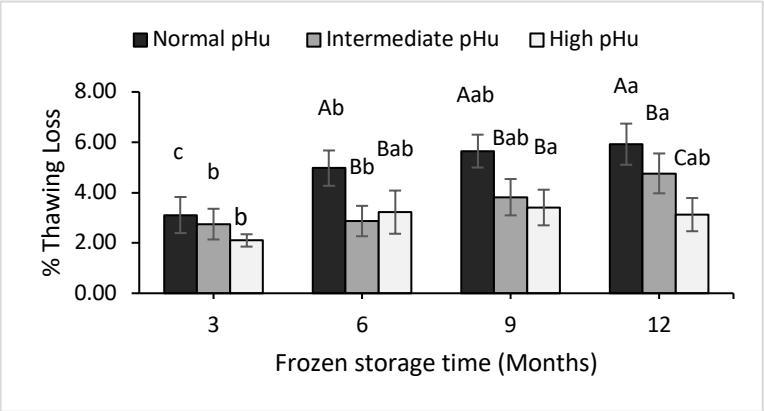

Figure 1. Effect of storage time on thawing loss (%) of M. *Longissimus lumborum* stored at -20 °C. Capital letters (A-C) indicate differences between pHu groups ($P<0.05$), lowercase letters (a-c) indicate significant differences between frozen storage time points ($P<0.05$).

The steaks that were frozen for 9 and 12 months had decreased luminosity (*L**) and increased redness (*a**), yellowness (*b**), protein and lipid oxidation (P<0.05) simultaneously (Table 1). Meat with normal pH_u had higher values for colour parameters (*L*, a*, b**) and greater lipid oxidation (P<0.05) at all storage times, and there were no significant differences in protein oxidation in the three pH_u ranges for all storage times.

Table 1. Effect of ultimate pH (pH_u) and frozen storage time on meat colour, lipid oxidation (TBARS) and protein oxidation (Carbonyl content) parameters (means ± SEM).

Variable		Parameters				
		*L**	*a**	*b**	TBARS (mg MDA/kg)	Carbonyl content (nmol/mg)
pH_u	Normal	34.2[a]	25.4[a]	17.3[a]	0.05[a]	2.00
	Intermediate	32.7[b]	23.4[b]	15.2[b]	0.05[a]	2.26
	High	31.2[c]	22.6[b]	14.4[b]	0.04[b]	2.48
Frozen storage time (months)	0	36.3[a]	21.7[d]	13.1[c]	0.03[c]	1.02[c]
	3	34.4[b]	22.5[c]	13.8[c]	0.04[b]	1.57[c]
	6	29.9[d]	24.2[b]	16.0[b]	0.06[a]	2.34[b]
	9	32.5[c]	25.1[a]	17.1[a]	0.06[a]	2.30[b]
	12	30.5[d]	25.3[a]	18.0[a]	0.04[b]	3.04[a]
SEM		0.779	0.505	0.629	0.004	0.216
P-value	pH_u	<0.001	<0.001	<0.001	<0.001	<0.001
	Time	<0.001	<0.001	<0.001	<0.001	<0.001
	Time x pH_u	0.89	0.82	0.63	0.75	0.67

Note: lightness (*L**), redness (*a**), yellowness (*b**), ultimate pH (pH_u), TBARS = thiobarbituric acid reactive substances. MDA= malonaldehyde; [a-d]: Means within a parameter with different letters (a–d) are different (P<0.05); SEM: Standard errors of means.

IV. CONCLUSION

These observations suggest that long periods of frozen storage, along with a 14-day maturation period prior to freezing, may favour meat colour intensity, but results in degradation of lipids and proteins and greater water loss.

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