EFFECT OF BEEF ULTIMATE pH ON MEAT SHELF LIFE OF FEEDLOT FINISHED NELLORE CATTLE

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I. INTRODUCTION

Insufficient postmortem pH decline increases the development of dark-cutting, which affects the appearance and the eating quality traits of meat and leads to a huge impact on consumers' purchasing decisions, affecting the beef industry [1]. Beside losses due to microbiological contamination, oxidation is the main factor responsible for low in quality and deterioration during storage time and reduction of the shelf life of meat [2]. Therefore, for the meat industry, the possibility of extending meat shelf life by delaying oxidative deterioration represents a significant goal [3]. Thus, this study was carried out to evaluate the effect of beef ultimate pH (pH_u) ranges on meat shelf life of feedlot Nellore cattle.

II. MATERIALS AND METHODS

A total of 110 Nellore bulls (535 ± 50 kg body weight and 24 mo old) were slaughtered and after 24 hours chilling, the meat ultimate pH (pH_u) was measured in the longissimus muscle (LM), between the 12ª and 13ª ribs, using an electrode probe attached to a portable pH meter (Hanna Instruments model HI99163, Sao Paulo, Brazil). Forty-nine out of 110 carcasses were selected by their pH_u and split into three different treatments: pH_u < 5.7 (low pH_u; n = 25), 5.8 < pH_u > 6.1 (intermediate pH_u; n = 14) and pH_u > 6.1 (high pH_u; n = 10). Afterward, 1.5 cm thick LM steaks were sampled, identified, individually vacuum packed, and aged (0 to 4 °C) during seven days. After ageing time, samples were allowed to bloom by environment exposition for 20 minutes at 4 °C to 6 °C and then lightness (L*), redness (a*) and yellowness (b*) of the meat was performed using a portable spectrophotometer model CM2500d (Konica Minolta Brazil, Sao Paulo, Brazil) with standard illuminant D65, observation angle of 10° and aperture of 30 mm. After that, samples were overwrapped in oxygen-permeable film on polyfoam trays and displayed for 3 and 5 days under simulated retail display conditions (Vertical model, 125 LX, Auden, Brazil; 4 °C; 1000 lux illumination) to determine shelf life of meat. After each display period, color was measured and lipid oxidation was quantified. Shelf life traits were analyzed as time repeated measures using the MIXED procedure, considering pH_u, display time and their interaction as fixed effects. The covariance structures were evaluated, and the best fit was used. The least squares mean statement was used to calculate the adjusted means for treatment. Differences were considered statistically significant when P < 0.05.

III. RESULTS AND DISCUSSION

Interaction effects. In general, high beef pH_u had the lowest a* and b* values over time than other pH_u ranges (Table 1). Loss of redness (a*) and changes in yellowness (b*) over a period of display have been used to describe meat browning [4]. These results suggest a higher but not intense meat discoloration after days on display, since both values are within the reference value for those traits [5].

pH_u effects. High pH_u group presented the lowest values for L*, suggesting that muscles with high pH_u have lower amount of reflected light due to the small amount of free water. Moreover, low pH_u group had higher formation of TBARS than the other pH_u ranges; however, both values were below the threshold established for the perception of off-flavors associated with oxidative rancidity [4].

Display time effects. Meat lightness decreased over five days on display, whereas the formation of TBARS increased throughout the retail display days, which were expected since lipid and myoglobin oxidation play an important role in meat establish and discoloration over storage time [6]. However, both values were considered normal for those traits [4,5].

Table 1 Effect of ultimate meat pH (pH_u) on color and lipid oxidation of longissimus muscle under simulated retail display conditions

Item	Time	pH_u			Mean + SEM	*P* value		
		$pH_u < 5.7$	$5.8 < pH_u > 6.0$	$pH_u > 6.1$		pH_u	Time	pH_u*time
L*	0	39.2 ± 0.92	37.7 ± 1.02	35.1 ± 1.10	37.4 ± 0.77^{a}	<0.0001	0.0194	0.6076
	3	39 ± 0.92	37.4 ± 1.02	35.4 ± 1.10	37.2 ± 0.77^{a}			
	5	36.5 ± 0.92	36.4 ± 0.02	34.5 ± 1.10	35.8 ± 0.77^{b}			
	Mean + SEM	38.2 ± 0.79^{a}	37.2 ± 0.81^{a}	35 ± 0.83^{b}				
a*	0	19.8 ± 1.42^{A,a}	15.4 ± 1.52^{B,b}	13.8 ± 1.62^{B,b}	16.3 ± 1.25	0.0277	0.0006	<0.0001
	3	18.7 ± 1.42^{A,a}	19.7 ± 1.52^{A,a}	17.6 ±1.62^{B,a}	18.7 ± 1.25			
	5	13.6 ± 1.42^{B,b}	18.4 ± 1.52^{A,a}	15.3 ± 1.62^{B,a}	15.8 ± 1.25			
	Mean + SEM	17.4 ± 1.29	17.8 ± 1.3	15.6 ± 1.32				
b*	0	16.3 ± 0.1^{A,a}	12.4 ± 1.06^{B,b}	10 ± 1.12^{B,b}	12.9 ± 0.88	<0.0001	0.0026	<0.0001
	3	15.4 ± 0.1^{A,a}	15.1 ± 1.06^{A,a}	12.9 ± 1.12^{B,a}	14.5 ± 0.88			
	5	12.4 ± 0.1^{B,b}	14.4 ± 1.06^{A,a}	11.6 ± 1.12^{B,ab}	12.8 ± 0.88			
	Mean + SEM	14.7 ± 0.91	14 ± 0.92	11.5 ± 0.93				
TBARS (mg MDA/kg tissue)	0	0.2 ± 0.06	0.1 ± 0.06	0.1 ± 0.06	0.1 ± 0.05^{b}	0.005	<0.0001	0.8658
	3	0.3 ± 0.06	0.1 ± 0.06	0.1 ± 0.06	0.2 ± 0.05^{b}			
	5	0.4 ± 0.06	0.3 ± 0.06	0.2 ± 0.06	0.3 ± 0.05^{a}			
	Mean + SEM	0.3 ± 0.05^{a}	0.2 ± 0.05^{b}	0.2 ± 0.05^{b}				

^{a,b} Values within a column with different lowercase letters differ significantly at $P < 0.05$.
^{A,B} Values within a row with different uppercase letters differ significantly at $P < 0.05$.

IV. CONCLUSION

High pH_u promotes lower redness and yellowness of meat over display time than others pH_u ranges, but it likely would not affect the consumer acceptance of meat.

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