EFFECT OF KIWIFRUIT JUICE AND WATER PRE-RIGOR INFUSION ON LAMB QUALITY.

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Introduction

Meat tenderness is of utmost importance to the red meat industry because of the higher financial gain associated with tender meat compared with less tender meat as demonstrated in the price difference between tender (e.g. fillet or porterhouse) and tough cuts (e.g. chuck or eye of the round). Furthermore, the production of consistent tender meat is required to retain consumers confidence in red meat which is competing for consumers purchase against other types of meat that is intrinsically do not have toughness problems (e.g. poultry). Several enzymes and ions have been used to accelerate meat tenderization through injection, marination or infusion. Papain and calcium chloride were the most studied and probably the most successful tenderizing agents. However, the activity of papain can not be controlled during the display of fresh meat and can lead to the undesirable "mushy" meat. Calcium ions on the other hand can reduce the colour stability of fresh meat and decrease the product shelf-life. In the present study we investigated the use of kiwifruit juice infusion in lambs as a new technique to improve the quality of lamb. Kiwifruit juice contains actinidin (a cysteine protease) and several antioxidants that might improve the overall lamb quality.

Materials and Methods

Meat samples: Eighteen lambs (12 months old) were assigned randomly to three postmortem (PM) treatments groups [control (C), water infused (W) and kiwifruit juice infused (K); average live weights were 41.0 ± 4.5, 40.9 ± 3.5, 41.9 ± 3.4 kgs; respectively]. The experimental design, infusion technique, sampling procedures and analyses were as described earlier[1]. The longissimus dorsi (LD) muscles and hind legs (LEG) were used to investigate the lamb quality at 1 and 21 days postmortem time. Meat allocated to 21 days postmortem analyses were sliced to 2.5 cm steaks, vacuum packed and stored at 2°C for 3 weeks. Meat tenderness was determined at 0.21(5hours), 0.5, 1, 2, 4, 6 and 21 days PM. Lipid oxidation was determined as thiobarbituric acid reactive substance (TBARS) at 0, 2, 4 and 6 days of display time for LD-1 day PM time, and at 0 and 6 days display time for LD-21 days PM and LEG samples of 1 and 21 days PM time. Surface colour of LD steaks and LEG chops was measured using Hunterlab MiniScan at 0.5, 1, 2, 3, 4, 5 and 6 days of simulated display at 4 ± 1°C. Data were analyzed using the REML routine in GenStat (GenStat Release 8.2) as described earlier[1].

Results and Discussion

Meat tenderness. Meat cut (LD vs LEG), PM, and infusion treatments and their pair interactions were significantly affected meat tenderness ($P < 0.001$. for all). Lamb carcasses infused with kiwifruit juice were more tender ($P < 0.001$) than C and W carcasses (Figure 1) with outstanding low shear force after 5 h postmortem. The effect of K treatment was greater than the effect reported for actinidin *in vitro*[2] or *in situ*[3,4] which probably resulted from higher enzyme activity in pre-rigor infusion due to the warmth of the carcass.

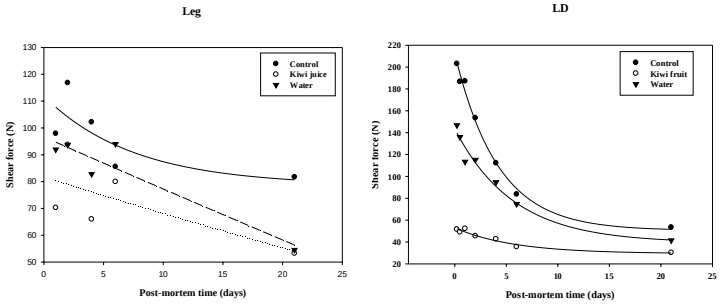

Figure 1. The effect of water and kiwifruit juice pre-rigor infusion on the tenderness of LD steaks and leg chops at various postmortem time.

Colour parameters. Lamb from W infusion treatment had higher ($P < 0.001$) L*-values throughout the display time compared with KW and Con (Figure 2). No differences were found between KW and Con. Lamb redness (a*) was not affected by infusion treatments ($P > 0.05$). Kiwifruit juice infusion had numerically higher a*-values in LEG samples. Yellowness (b*) had similar trend as L* values with meat from water infused carcasses had higher ($P = 0.021$) b* values and no differences were found in KW and Con treatments (Figure 2). These results shows that the KW treatment did not exert any negative effects on lamb colour unlike calcium treatment[1,5]. In fact, there was a slight advantage of KW infusion on a* values for LEG after 21 days of postmortem storage.

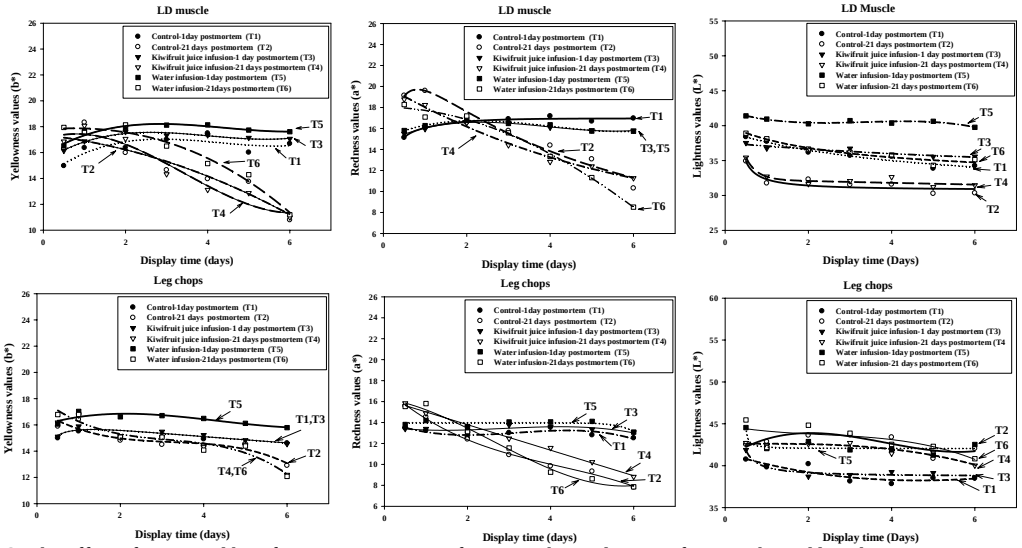

Figure 2. The effect of water and kiwifruit juice pre-rigor infusion on the tenderness of LD steaks and leg chops at various postmortem times. SEDs are 5.83, 1.54 and 0.68 for L*, a* and b*, respectively.

Lipid oxidation. There was no effect for the infusion treatments on lipid oxidation level over 6 days display time in LD-1 day postmortem, whereas initial (0 display time) lower ($P < 0.05$) TBARS values were found in W and K treatments compared with C (Figure 3). That advantage of K disappeared after 6 days of display time at 4°C. Water infusion was shown to reduce the amount of myoglobin compared with controls[1] which can lead to a decrease in the lipid-meat pigments reciprocal oxidation. An interesting finding was that K treated meat exhibited lower ($P < 0.01$) TBARS in 21 days PM LD and LEG cuts after 6 days of simulated display (Figure 3). Kiwifruit juice is rich in natural antioxidants (vitamin C and other polyphenols) which may be conserved during the vacuum packaging storage (stored at 2°C for 21 days) and become available to inhibit oxidation during display.

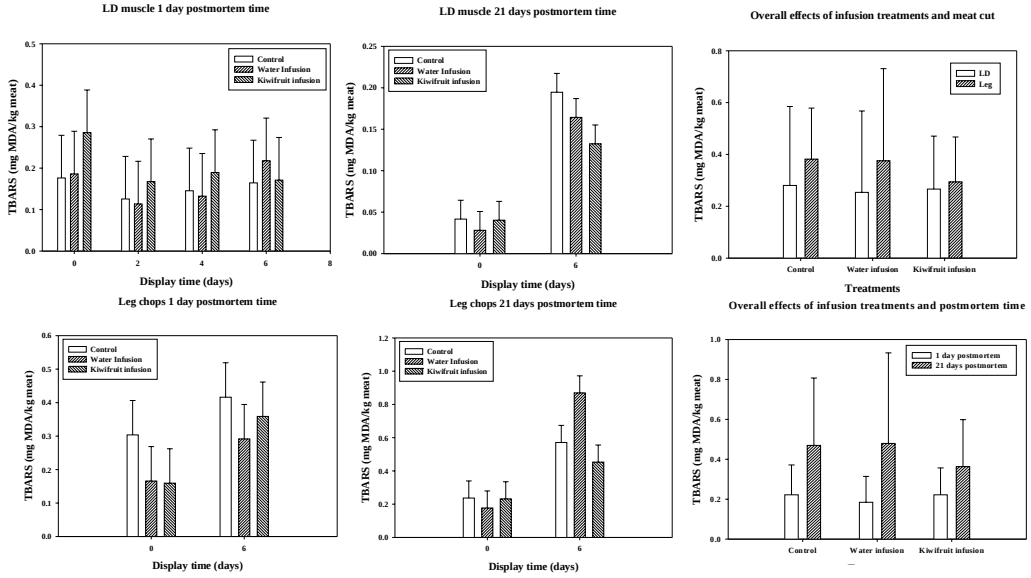

Figure 1. The effects of water and kiwifruit juice infusion on TBARS (mg MDA/kg of fresh tissue) values of LD steaks and leg chops at 1 and 21 days postmortem time display for various times at 4°C.

Conclusions

The reported findings demonstrate that kiwifruit juice was very powerful meat tenderizer and decreased lipid oxidation in meat of 21 days postmortem after 6 days display period with a slight advantage for the colour stability of leg meat at the same postmortem time. These findings represent a new technology for the meat industry to produce a consistent tender meat with additional oxidative stability benefits.

References

1. Bekhit, A. E. D., et al. (2005). *Journal of Animal Science*, 83, 2189-2204.
2. Wada, M., et al. (2004). *Food Science and Technology Research*, 10, 35-37.
3. Lewis, D. A. and Luh, B. S. (1987). *Journal of Food Biochemistry*, 12, 147-158.
4. Samejima, K., et al. (1991). *Journal of Japanese Social Food Science and Technology*, 38, 817-821.
5. Geesink, G. H. et al. (1994). *Sciences Des Aliments*. 14, 485-494.