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CHARACTERIZATION OF KNOWN AGE BRUISES IN BEEF CATTLE THROUGH INNOVATIVE FORENSIC TECHNIQUES

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1 INTRODUCTION

Bruises are a very good indicator of compromised animal welfare and represent the principal economical loss for the meat industry, according to the three Uruguayan quality audits. The last audit showed that 71% of the carcasses had at least one bruise and 24% had at least one implying muscle removal (del Campo et al., 2017), being 37% of the annually meat chain losses (Brito et al., 2017). Knowing bruises age and the moment where they have probably been inflicted, would make it possible to build corrective measures, educate and train the people directly involved. The aim of this study was to characterize bruises of diverse known ages, through different techniques.

2 MATERIALS AND METHODS

- ✓ Animals: 60 Hereford steers, 30 months old and 530 kg of liveweight

1 bruise per steer, affecting muscle at the rump region, was inflicted at different pre-slaughter times.

- ✓ Treatments: T1: 1 hour, T2: 5, T3: 9, T4: 13, T5: 17 and T6: 23 hours pre-slaughter

Determinations at the abattoir:

- ✓ Bruises ***color***: Gracey's visual scale, from red bright to orange, associated to time. Objective color at the L*, a*, b* space (Konica Minolta colorimeter, CR-400)
- ✓ ***Elasticity*** at healthy and injured tissue by elastosonography
- ✓ ***Temperature*** at healthy and injured tissue through infrared thermography (IRT; PALMER WHAL camera, HSI 3000)


ELASTICITY

Subsamples of injured tissue were extracted and preserved in formaldehyde. After 24 hours, microscopic analysis were performed at the laboratory.

Determinations at the laboratory:

- ✓ ***Hemorrhage***: presence or absence
- ✓ ***Inflammatory infiltrate***: grade scale from 0 (absence) to 3 (severe) and location (adipose-connective, muscle, or both tissues)
- ✓ ***Edema***: presence or absence
- ✓ ***Necrosis***: grade scale from 0 (absence) to 3 (major)
- ✓ ***Fibrosis***: presence or absence

3 RESULTS/DISCUSSION

Neither subjective nor objective ***color*** differed between T.

- ✓ ***Elasticity*** of muscle fibers differed between healthy and injured tissue ($p<0,05$). Within each treatment, the velocity was slower in the injured tissue, due to less homogeneous muscle.
- ✓ ***Temperature*** also differed between healthy and injured tissue from the same muscle ($p<0,05$), probably because of a greater energy exchange with the environment and the rupture of the blood vessels in the injured region. This difference was greater in older bruises ($p<0,05$, Table 1) being a promissory variable.

Table 1. Temperature of injured and healthy tissue and its difference (IRT), by grouped treatments.

Group of treatments	Temperature of healthy tissue THT	Temperature of injured tissue TIT	THT - TIT
≤ 5 hours (T1 and T2)	29,90	27,73	2,17
9 and 13 hours (T3 and T4)	31,66	29,29	2,37
≥ 17 hours (T5 and T6)	31,17	28,14	3,03


INFRARED THERMOGRAPHY

- ✓ The presence of ***inflammatory infiltrate***, its severity and location, did not differ between treatments.
- ✓ ***Edema*** increased vascular permeability and is one of the classic inflammation indicators. In 100% of the subsamples (n = 52), with hemorrhage and inflammatory infiltrate, the presence of edema was verified. However, it was not related to bruises age.
- ✓ ***Fibrosis*** was not observed in this experiment.
- ✓ ***Necrosis*** was reported in 56% of the bruises and 82% of them were Grade 1. The grade of necrosis was associated to bruise age ($p<0,05$), registering grade 2 only in bruises with more than 13 hours (T5 and T6), and grade 3 only in bruises with more than 17 hours (T6). Since the average lairage time at the slaughterhouse is 12 hours in Uruguay, necrosis grade 1 could be associated to bruises inflicted at the farm or during transport and grades 2 and 3, to bruises inflicted at the abattoir.

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4 SUMMARY/CONCLUSIONS

- Elastography detected differences between healthy and damaged tissue.
- Only infrared thermography and necrosis were associated to bruises age.
- Further rigorous research should be conducted, looking for those relationships.