BEEF SURFACE MYOGLOBIN FRACTIONS AS INFLUENCED BY BREED, ELECTRICAL STIMULATION, AGEING AND BLOOMING

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Abstract – Feedlot raised Angus (n=10), Bonsmara (n=10), Brahman (n=11), Charolais (n=9) and Nguni (n=10) young bulls were slaughtered and the carcasses halved. Right sides were electrically stimulated within 60 minutes *post mortem* (400 V peak, 20 sec) and chilled at 4°C. Left sides were not electrically stimulated and chilled for 6 hours at 10°C, thereafter at 4°C. *M. longissimus lumborum* samples were cut into steaks and vacuum packaged 24 hours post mortem. Steaks were aged at 4°C till 9, 14 or 20 days post mortem. After ageing, samples were taken from vacuum, and surface reflectances measured 0 and 60 minutes after opening from 400 to 740 nm (10 nm increments). The myoglobin fractions Metmyoglobin, Deoxymyoglobin and Oxymyoglobin were calculated. Breed influenced the myoglobin fractions significantly (P<0,01), Brahman having the highest Metmyoglobin and Oxymyoglobin, but lowest Deoxymyoglobin concentrations. Charolais showed the opposite trend, with other breeds being intermediate. Electrical stimulation had no influence (P>0,05) on any of the myoglobin fractions. Ageing period increased Metmyoglobin (P <0,01), but had no influence (P>0,05) on Deoxymyoglobin and Oxymyoglobin concentrations. Blooming had no effect on Metmyoglobin, but reduced Deoxymyoglobin and increased Oxymyoglobin concentrations (P<0,05). Various interactions of the main parameters were also found to influence the different myoglobin fractions.

Key Words – Myoglobin redox forms, Surface reflectance measurements, Vacuum packaging

- INTRODUCTION

Meat colour is the most important quality criteria when meat is being purchased by the consumer [1, 2, 3]. Generally a bright cherry-red colour is more appreciate by consumers as it is associated with freshness and wholesomeness [4]. The cherry-red colour is naturally attained when the myoglobin in the meat is oxygenated. However, various factors have been found to influence the colour of meat, such as breed, vacuum packaging *per se*, the period post mortem after which colour is evaluated, as well as the time allowed for the blooming (oxygenation) of the meat (myoglobin) [4, 5].

The present study investigates the influence of some of these factors on the different myoglobin fractions on the surface of meat.

- MATERIALS AND METHODS

Young bulls (breeds Angus (n=10), Bonsmara (n=10), Brahman (n=11), Charolais (n=9), Nguni (n=10)) were raised in a feedlot at the ARC-Animal Production Institute (ARC-API) at Irene, South Africa. After reaching a live mass which would produce a carcass of Class A (no permanent incisors), and fat class 2 to 3 (1-≤5 mm) (South African Beef Classification System), the animals were slaughtered at the ARC-API abattoir. After standard dressing procedures, carcasses were halved. Right sides were electrically stimulated (ES) at 400 V peak, a 5 msec pulse at 15 pulses/sec within 60 min post mortem and chilled at 4°C. Left sides were not electrically stimulated (NES), and chilled at 10°C for 6 hours, and thereafter at 4°C. *M. longissimus lumborum* samples were taken 24 hours post mortem from both sides, and cut into approximately 1 cm thick steaks. Steaks were vacuum packaged and aged for

either 9, 14 or 20 days in a chiller at 2°C

Steak surface absorbances were measured on three different positions on a steak (average used for analyses) after blotting it dry with paper towel directly after the steak was taken out of the vacuum packaging (Bloom 0) and blooming at room temperature for 60 min (Bloom 60) from 400 to 740 nm in increments of 10 nm. A Konica-Minolta 600d spectrophotometer was used with the software package SpectraMagic NX Pro (Konica-Minolta). The spectrometer configuration was as follows: illuminant D65, geometry di 8° de 8°, observer angle 10°, measurement aperture 8 mm. Measurements were taken excluding the spectral component (SCE), after calibration using the included white reference.

The myoglobin fractions metmyoglobin (MetM), deoxymyoglobin (DeoxyM) and oxymyoglobin (OxyM) were calculated according to Krzywicki [6] using the reflex attenuation (log 1/R) at the isobestic points 572, 525 and 473 (calculated by linear interpolation), and at 730 nm.

Statistical analyses (ANOVA) were done using the XlStat-Pro statistical programme (Addinsoft).

- RESULTS AND DISCUSSION

Breed had a highly significant influence ($P<0,01$) on all the myoglobin fractions (Table 1). The Brahman had the highest MetM and OxyM, and the lowest DeoxyM concentration (Fig. 1). The Charolais and Ngunis had the highest DeoxyM concentration, and this was reflected in the lowest OxyM concentration (Fig.1). However, King *et al*. [7] using K/S ratios did not find any breed influence on MetM. In their study Charolais tended to have the lowest MetM content, which is similar to the findings of this study.

As can be expected blooming had no influence on MetM (Table 1). Blooming resulted in a significant drop in DeoxyM directly after opening the vacuum bag to 60 min after opening the bag, which also resulted in a significant increase in OxyM as the DeoxyM was oxygenated to OxyM (Fig. 2), similar to the results of Ledward [8]. A significant interaction ($P<0,01$) was found in both DeoxyM and OxyM between breed and blooming. The Charolais and Ngunis breeds have a slower rate of blooming than the other three breeds, and consequently a slower decrease in DeoxyM (Fig. 3 & 4).

Electrical stimulation had no influence ($P>0,05$) on any of the myoglobin fractions (Table 1). It was expected to play a role in that various publications have indicated a brighter red colour (CIELab a* values) for electrically stimulated meat [9]. Hence an improved CIELab a* value may not directly be related to OxyM concentration. This is supported by Sleper *et al*. [10] who found in fresh meat higher a* values in electrically stimulated meat, with no consistent differences in myoglobin fractions.

Higher MetM concentrations are associated with a decrease in colour acceptability [11]. The probability of higher MetM is greater the longer the ageing period, which was found in this study (Table 1). However, ageing period *per se* did not have any significant influence on the level of DeoxyM or OxyM, although the interactions between the ageing period and bloom were significant ($P<0,05$, Table 1).

The same was found in OxyM concentrations with the interaction ageing period and bloom, and by the differences in OxyM levels at 0 and 60 minutes of blooming, albeit in the opposite direction as DeoxyM.

- CONCLUSION

Surface MetM, DeoxyM and OxyM fractions are influenced by breed, whereas MetM is influenced by ageing period, and DeoxyM and OxyM by blooming time. Various interactions of the main effects breed, ageing and blooming period were also found.

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