EVALUATION OF A SIMPLE METHOD TO MEASURE BLOOM DEPTH IN LAMB MEAT

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Abstract-

The accuracy of a technique designed to measure the depth of colour change due to "bloom" in lamb loin meat was investigated. This involved the interpretation of digital images by two different human observers. Digital images of the bloom depth in loin meat from 40 crossbred and Merino lambs was measured at 1, 6 and 24 hours post slicing. There was a poor correlation between the two observers and the slope of the relationship observed was less than 1. This technique was neither sufficiently accurate nor precise enough to compare bloom depth hence oxygen consumption rate, of lamb loin meat due to differences between the human observers for interpretations of the images.

Key Words – bloom depth, lamb loin, colour

I. INTRODUCTION

Bloom is often reported in the literature as a change in colour measured at the surface using a colorimeter [1]. Bloom occurs due to the binding of oxygen to myoglobin to form oxymyoglobin and surface colour depends on the depth to which oxygen penetrates into the tissue [2]. Bloom depth is a function of both the oxygen partial pressure at the surface and the rate of oxygen consumption by the meat tissue [3]. So the depth of the colour change is an indication of the depth of oxygen penetration hence the oxygen consumption rate of meat but is more difficult to measure than surface colour. Quantifying bloom depth directly could help elucidate causal factors that influence meat colour and colour stability via oxygen consumption rate [4]. Meat that blooms well tends to be lighter, redder and more stable in colour [5]. This study aimed to compare values from two human observers for the bloom depth of lamb loin meat estimated at different times post mortem, to determine the accuracy of a method devised to measure bloom depth directly.

II. MATERIALS AND METHODS

Bloom depth was measured using a semi-automated technique that depended on human observers measuring the depth of bloom from a digital meat image (Figure 1). Loin (*m. longisimuss thoracis et lumborum*) samples from 40 lambs were overwrapped with oxygen permeable polyvinyl chloride clingwrap on a black Styrofoam tray and bloom was measured subsequently at 1, 6 and 24 hours post slicing. This was part of a larger experiment that tested the effects of sheep breed (crossbred and merino), electrical stimulation, refrigeration conditions (chilled or frozen) and ageing period post slaughter (2, 6 and 60 days); on meat colour. Individual meat samples from each lamb were stratified according to their position in the loin and allocated to each treatment such that position was equally distributed between treatments. Lambs were slaughtered at a commercial abattoir, with a mean carcass weight of 28kg.

At the time of bloom measurement (1, 6 or 24 hours), each sample of meat was resliced in a direction that was orthogonal to the surface exposed to oxygen at the initial time of slicing. This created a new surface from which the depth of bloom could be visualised. Samples were then placed on a Canon Lide 700 scanner in lots of 5 samples with the freshly sliced orthogonal surface facing down on the scanner bed, with a calibrating ruler included in the image. A digital image was then captured of the orthogonal surface for later viewing and the sample subsequently discarded. The depth from the surface was subsequently measured by two observers using Image J software (https://imagej.nih.gov/ij/). This involved placing the mouse cursor on the image at the meat surface and again at the boundary between the red and purple layers below the surface. The software then computed the distance between these two positions with the value being calibrated to length (mm) against the ruler included in the image. This process was replicated 3 times for each image at 3 different locations on the meat image (25% distance from left edge, centre and 25% distance from right edge).

III. RESULTS AND DISCUSSION

The strength of the correlation between each observer was less than expected and decreased as the time from slicing increased from 1 to 24 hours (Figure 2). Furthermore the coefficient or slope of the relationship was different to the expected value of 1. Bloom depth increased and become more variable as time post slicing increased. So the perception of the change in colour from red to purple appeared to differ for the two observers. The reasons for this could include differences in perception of colour, computer monitor differences and the reference points varying between the observers.

Figure 1 A representative image of the samples measured.

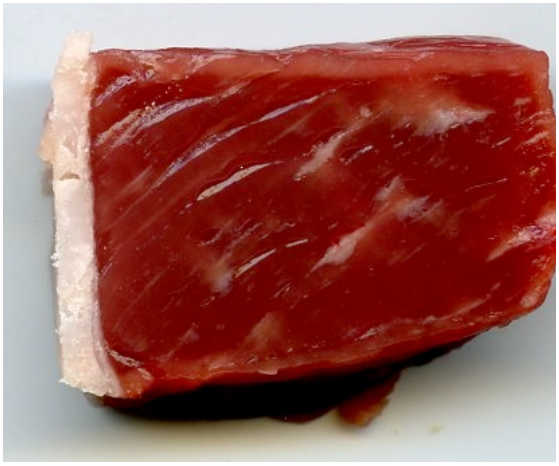
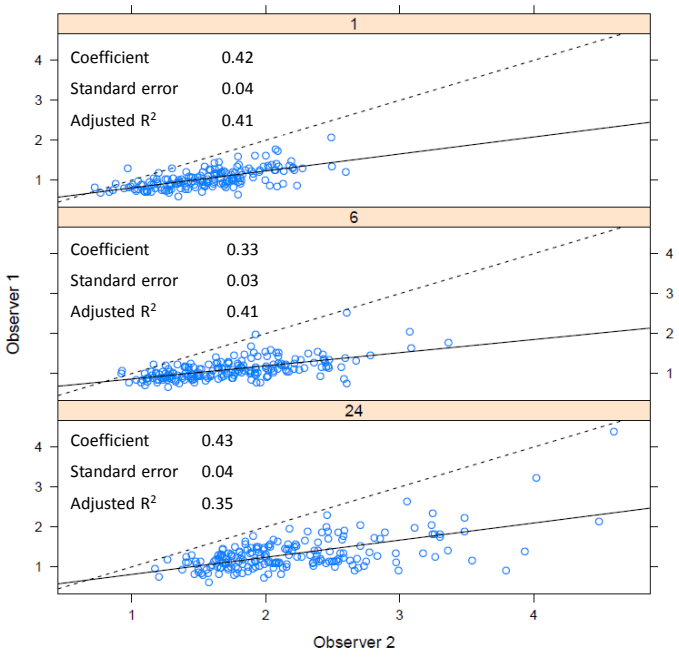


Figure 2 The bloom depth (mm) of lamb loin estimated by observer 1 (y axis) compared to observer 2 (x axis) at 1, 6 and 24 hours post slicing. Blue circles represent individual samples, dashed line is the one to one line relationship ($x_i=y_i$) and solid line the line of best fit.



IV. CONCLUSION

The method investigated to measure bloom depth was neither accurate nor precise due to an apparent difference between the human observers for the interpretation of colour change from red to purple. A way of analyzing digital reflectance data directly without the need for humans to observe an image should be investigated.

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