EFFECT OF MEASUREMENT TEMPERATURE AND TIME OF STORAGE ON FAT COLOUR OF VACUUMED-PACKAGED BEEF

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The fat on carcases derived from grazing cattle is usually a creamy-yellow colour which results from yellow pigments that occur naturally in pasture grasses and forages. Cattle, unlike sheep, goats and buffalo, which have white fat irrespective of diet, are able to absorb and deposit considerable quantities of these yellow pigments in their fatty tissues producing a range of creamy/yellow carcase fat. These fat soluble pigments have been identified as carotenoids. The major carotenoid present in fat of cattle is β-carotene (Yang et al., 1992) which is only a minor component of the yellow pigments present in plants. The appearance of yellow fat is therefore indicative of a pasture-fed product, which some consumers consider may be associated with an odour and flavour that are less attractive. As the beef industry in Australia is still largely pasture-based, yellow fat colour is often excessive. Data collected from nearly 100,000 grass-fed steers from Queensland revealed that 35% had fat colour scores of 6 or more, which would have been unacceptable for the Japanese and Korean chilled beef markets. Thus, fat colour is an important factor in ensuring optimum returns for the pasture-based industry.

Japan is Australia's most valuable export market for chilled beef and this market has very specific requirements for the quality of the meat. Japanese consumers tend to associate lighter fat colour along with bright red meat colour as an indicator of freshness of product, an attribute that ranks highest when purchasing meat for home use. The contrast between bright red meat and white fat is greater, making the product more visually appealing. In Australia, fat colour is part of AUS-MEAT Chiller Assessment for specifications of beef. There have been anecdotal observations in the Australian meat industry that fat colour may decrease with time of storage and therefore the initial assessment may result in undervaluing the product. Earlier overseas work reported conflicting observations on the effect of temperature on fat colour (Barton, 1968; Morgan et al., 1969). All these observations, however, were made from subjective assessment of fat colour on beef carcases. We therefore conducted an experiment to study the effect of measurement temperature and storage time on fat colour of vacuum packaged beef using an objective fat colour assessment.

Methods

Striploins (13) were selected and removed from cow carcases 24 hour post mortem in the boning room and sliced into ~5 cm sections at around 8-10°C. The surface of subcutaneous fat was trimmed before the initial fat colour of each slice was obtained using a Minolta Chromameter at the same temperature. The b* value of the CIE L*a*b* system was found to correlate closely with the carotenoid concentrations in fat (Strachan et al., 1993) and was therefore used as the indicator of fat colour. The slices were then vacuum packaged and one slice from each loin was randomly allocated to be stored for 2, 4, 6 or 8 weeks at 0°C in the dark. At the end of each storage period, the vacuum package was opened and fat colour was measured on the same area as the initial reading at a temperature of 8-10°C. The sample was then warmed up and equilibrated to around 22°C before fat colour was measured again. The carotenoid concentration was determined by a high performance liquid chromatography method. The data were analysed for analysis of variance using SAS.

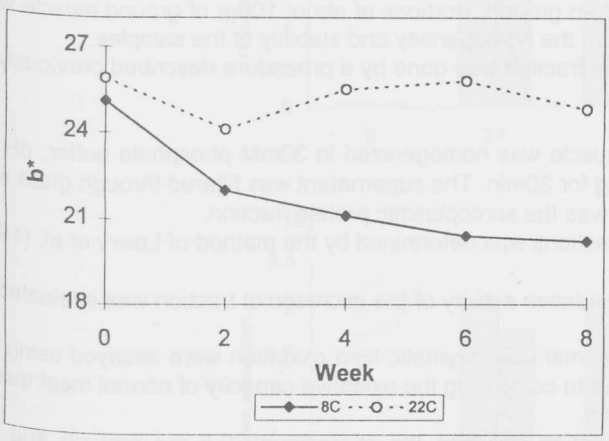
Results and Discussion

The effect of temperature and time at which fat colour was measured on the fat colour of beef during vacuum-storage at 0°C is shown below. There was a significant increase in fat colour, b* value, when the measurement temperature was increased from around 8 to 22 °C ($P<0.001$) except at week 0. At 8°C, there was also a gradual decrease in fat colour from week 0 to week 8 (25.1 to 20.2). This reduction in fat colour over storage time was, however, not observed when the samples were warmed to 22 °C. There was no decrease in the carotenoid content in these samples at the beginning and the end of this experiment.

The temperature at which fat colour is measured and storage time may affect fat colour in a number of ways. Surface drying and solidifying of fat during cooling, for example, may change the colour intensity visually. In addition, fat undergoes crystallisation during cooling, it becomes more opaque and the fat-soluble pigments such as carotenoids become less visible, thus giving a visual impression of whitening of fat on cooling. With increased duration of storage at 0°C, the crystalline triglyceride components of fat tissue will undergo polymorphic changes until they reach a most stable form (Timms, 1995). These changes are usually associated with fat having a higher melting point and becoming very hard and opaque at chiller temperatures. When fat colour was first measured at 8 °C after samples had been collected from carcases held in the chiller overnight, it is likely that the fat was still undergoing crystallisation and therefore the temperature effect on fat colour was not as obvious. When the fat was further chilled at 0°C for days and weeks, the initial crystallisation process and polymorphic changes were complete, thus the effect of temperature on fat colour was significant.

In conclusion, the time and temperature at which fat has been kept had an effect on fat colour of beef.

Effect of measurement temperature and time on fat colour (b* value, n=13) of beef during vacuum storage at 0°C



Data for the figure:

Week	8°C	22°C	Significance
0	25.1[a1]	25.9[a]	n.s.
2	22.0[b]	24.1[c]	***
4	21.1[c]	25.5[ab]	***
6	20.4[cd]	25.8[a]	***
8	20.2[d]	24.8[b]	***
Average	21.7	25.2	***

n.s. not significant ($P>0.05$); *** $P<0.001$

[1] Means within the column with the same superscript are not significantly different ($P>0.05$).

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