NEW INSIGHTS INTO MEAT COLOUR

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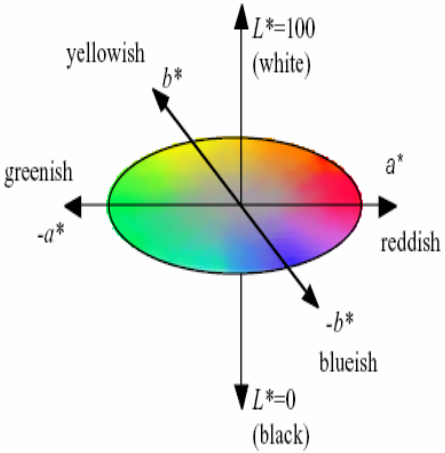

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Current status of meat colour

- The importance of colour in meat merchandising is well recognised
- ~ 15% of displayed meat products are discounted because of colour
- A number of the factors affecting the colour and colour display life of meat have been determined
- Oxygen consumption/metmyoglobin reduction role in determining the colour stability of meat is yet to be fully understood
- Centralised packaging and case ready fresh meat is growing
- MAP to extend the colour display life of meat continue to evolve

Meat colour issues relevant to the NZ processor

- Decrease in the colour display life of meat with aging
- The rapid deterioration of venison colour
- Measures taken to improve tenderness impact negatively on colour
- The demand by some supermarkets for supplier assurance of colour display life (7 days for Mark Spencer)
- The lack of a standard objective method of determining colour
- The lack of an objectively measurable cut off level of colour that is acceptable to consumers
- The lack of a method to predict the colour and colour stability of chilled stored meat early postmortem

Current methods of extending the colour display life of meat

High oxygen MAP

- Most products are packaged in high oxygen to maintain bloom and carbon dioxide (20%) to prevent microbial growth
- Typical MAP environment: 80% oxygen/20% carbon dioxide

Low oxygen MAP

- The use of carbon monoxide (< 0.4%) to extend the colour display life of meat is gaining wider acceptance with its recent approval in the USA
- Typical MAP environment: 0.4% CO/30% CO2/ 69.6% Nit.

Re-generating the MetMb reducing capacity of meat

- Achieved through vacuum packaging of discoloured meat to allow the reducing capacity to be re-generated
- MetMb (brown) is reduced to de-oxymyoglobin (purple)

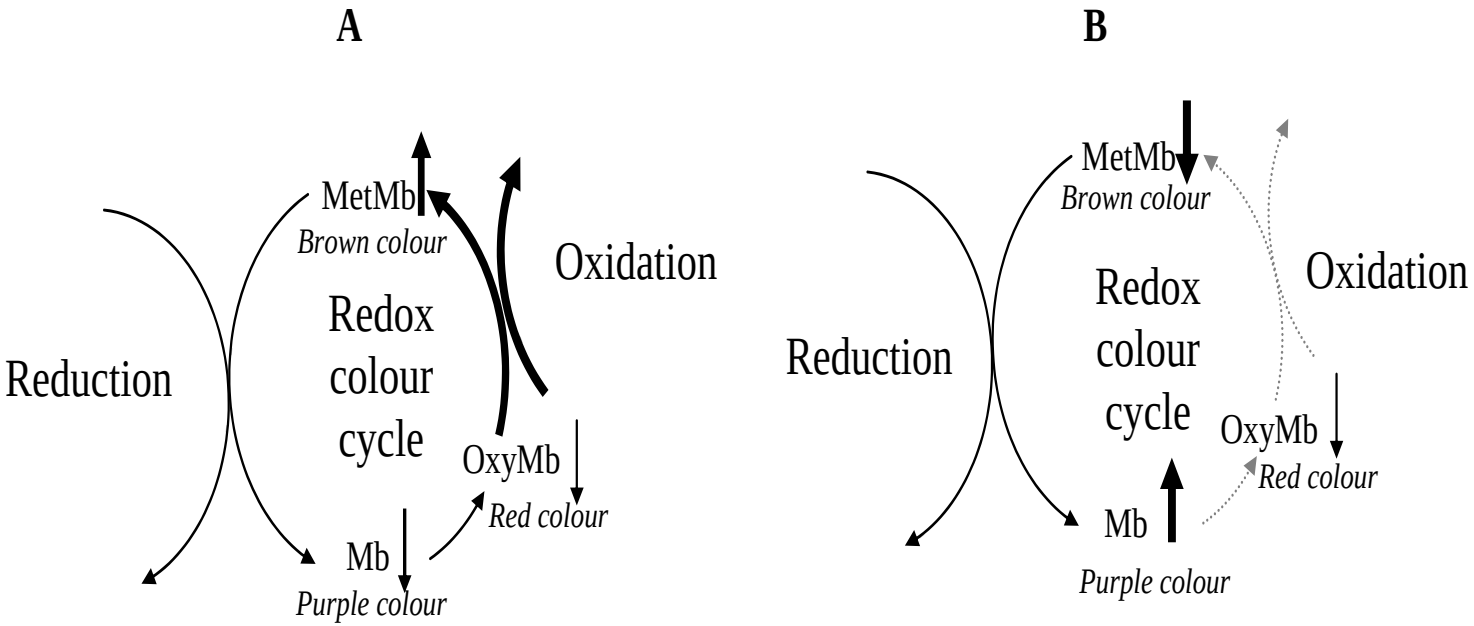
Current objective measurements of meat colour

Instrumental colour measurements

- Hunter and Minolta colour meters
- Various colour systems, illuminants and observers

Computer vision

- Based on analysis of digital camera images
- Entire surface is measured compared to the point-to-point obtained using Minolta or Hunter colour meters
- Better correlation with visual colour compared to Hunter or Minolta



Bekhit, Cassidy, Hurst and Farouk (2006), Meat Sci. In Press

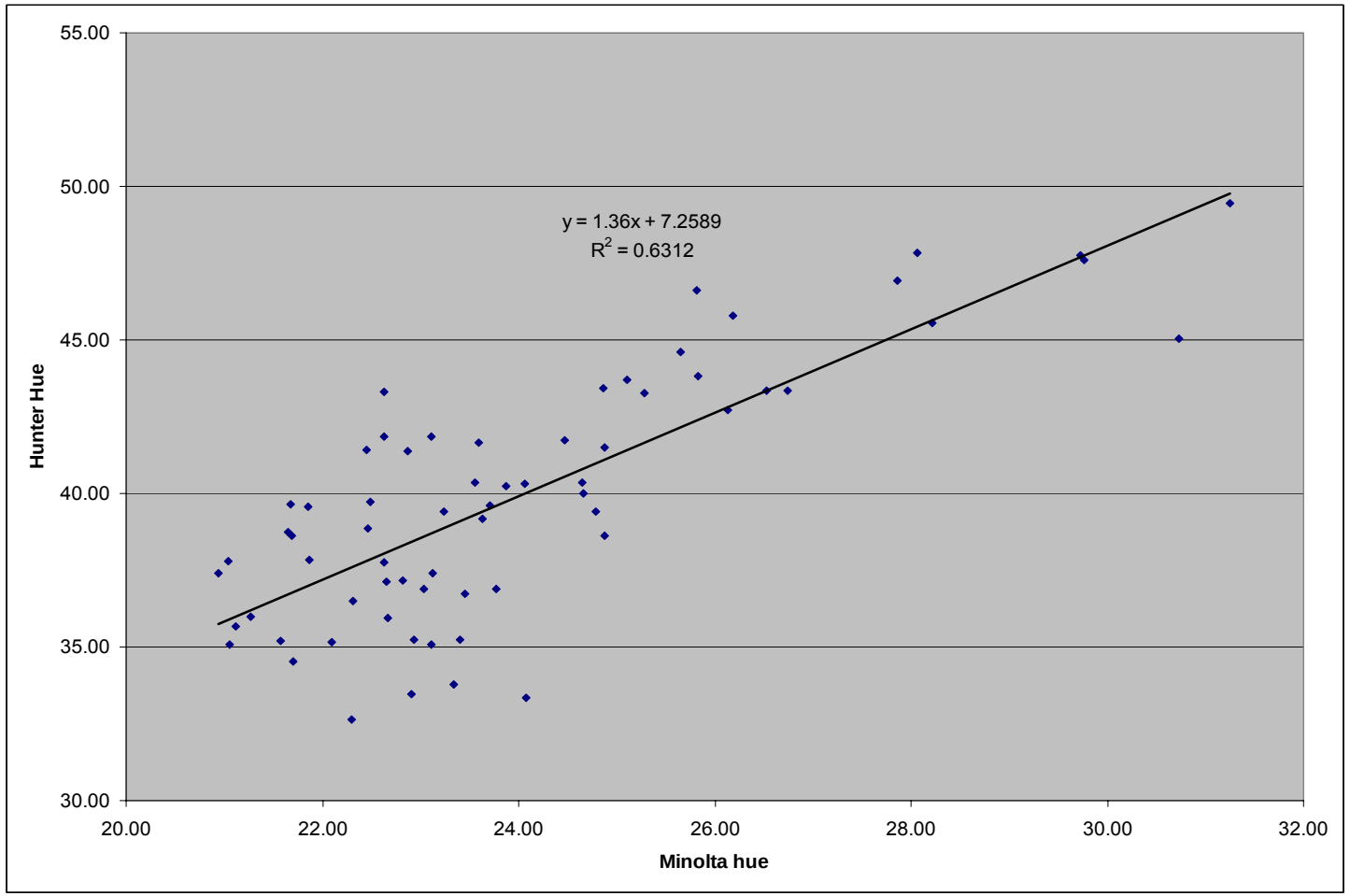
New insights. Baseline meat colour

In-house consumer panel

- Hunter and Minolta colour meters
- Samples displayed in a simulated retail cabinet for 14 days and panellist scored the meat for acceptability and willingness to buy
- Colour continuously changed with time

Fieldays consumer panel

- Minolta colour meter
- Freshly bloomed steaks of predetermined colours were evaluated for acceptability and willingness to buy by the consumer
- Evaluation went on for four days using freshly bloomed steaks each day



Hunter Hue =1.36*Minolta Hue + 7.26

New insights. Baseline meat colour cont.....

Results and implications:

- Correlation between % willing to buy and Minolta hue angle was stronger (r = 0.9) for the fieldays data compared to the in-house (r = 0.7)
- Not more than 85% of the consumers were willing to buy steaks on the basis of colour at any one time
- Factors other than meat colour were also contributing to the consumer point of purchase decisions (e.g. the effect of the adjacent steak)

Minolta in-house and fieldays consumer cut off scores

- Minolta a* (redness) cut off value = ≥ 14
- Minolta hue angle (brownness) cut off value = ≤ 26 degrees
- Hunter hue angle cut off value = ≤ 43 degrees

New insights. Boosting meats antioxidant capacity: A Natural solution?

- More evidence of strong link between lipid oxidation and colour stability
- Evidence exist of the use of diet supplementation of Vit E to improve colour stability
- Could the measurement of naturally occurring reducing agents or antioxidants in meat (e.g glutathione) early postmortem provide the tool for predicting the colour stability of aged meat during retail display?

New insights. Boosting meats antioxidant capacity: A Natural solution? cont....

Experiment

- Lambs finished on three diets (white clover, rye grass and *lotus pedunculatus*)
- Colour stability was determined on days 1, 21 & 64 days of vacuumed chilled storage at -1.5C
- Colour stability was evaluated using Hunter colour meter for 14 days
- Days 7, 8, 9 & 10 hue angles were focussed on

Results

- Meats from animals finished on L. *pedunculatus* were lighter
- Meat from animals finished on rye grass tended to have more stable colour (less browning)
- Nitrogen content of diet seems to have a stronger effect on colour compared to its antioxidant content
- Fat content and oxidative state affects colour stability

New insights. Possible early postmortem indicators of chilled meat colour stability

Indicators in at rigor meat

- Liver Gammaglutamyltransferase (GGT)

Indicators in 3 weeks old meat

- Indole in loin
- Liver GGT

Indicators in 9 weeks old meat

- Hydroxymethyloxindole in blood
- Liver GGT
- Indole in blood
- Indole in the loin
- P-cresol in loin

New insights. Early postmortem indicators of thawed meat colour stability

L* = 43.2 - 0.31 x Initial rate of temperature fall, °C/hr **(1)**
+ 3.3.0 if muscle is ST
(r = 0.8, residual standard error = 2.0)

a* = 17.0 - 0.11 x Initial rate of temperature fall, °C/hr **(2)**
(r = 0.5, residual standard error = 1.6)

b* = 8.7 - 0.14 x Initial rate of temperature fall, °C/hr **(3)**
+ 1.9 if muscle is ST
(r = 0.8, residual standard error = 0.9)

Hue angle = 25.8 - 0.23 x Initial rate of temperature fall, °C/hr **(4)**
+ 5.2 if muscle is ST
(r2 = 0.8, residual standard error = 2.0)

Farouk & Lovatt (2000). Meat Sci. 56, 139.

Conclusions

- Extending the colour display life of meat is an important consideration for the Meat Industry particularly for those with distant markets
- Development in packaging particularly the use of CO-MAP is one way colour display life can be extended beyond the current HO-MAP. Important markets are yet to be convinced
- Boosting the inherent anti-oxidant capacity of meat is another way colour display life could be extended
- There are new ways of objectively measuring and predicting the colour and colour display life of meat, these need to be further validated
- The role of oxygen consumption rate and metmyoglobin reducing activity in determining the colour and colour display life need to be further understood and exploited

Recommendation

- The use of CO-MAP to extend the colour display life of NZ processed beef and lamb need to be thoroughly investigated to prepare for the eventual global acceptance of the process
- Naturally boosting the anti-oxidant capacity of meat to extend colour display life should be pursued
- A way of educating consumers at the point of purchase to disregard colour in merchandising venison need to be determined
- The new ways of objectively measuring and predicting the colour and colour display life of meat should be further be validated
- The display of meat at the retail need to be modelled so that the possible negative impact of adjacent trays on colour display life could be neutralised

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