
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

## BRIEF COMMUNICATION

# Plasma carotenoid concentrations early in life can be used as a selection criterion for fat colour in heifers

A.F. DEATH, T.W. KNIGHT[1], R.W. PURCHAS[2], S.T. MORRIS[2] AND D.L. BURNHAM[2]

AgResearch Flock House Agricultural Centre, Private Bag 1900, Bulls, New Zealand.

## ABSTRACT

Plasma carotenoid (PC) concentrations were measured at 2-5 month intervals in 20 Hereford x Jersey (HJ) and 20 Hereford x Friesian (HF) once bred heifers from 10-35 months-of-age. Half of the heifers were slaughtered at 31 months-of-age and the rest at 35 months-of-age. The colour of the subcutaneous and intermuscular fat was measured using a chromameter and c* values were calculated. Subcutaneous and intermuscular fats in HJ heifers were yellower (i.e. they had higher c* values) than in HF heifers. Regression equations that included breed, date of slaughter and PC concentrations at 10-12 months-of-age, accounted for 56% of the variation in c* values for subcutaneous fat and 40% of the variation in c* values for intermuscular fat (P<0.001).

**Keywords:** carotenoids; fat colour; beef; selection; breed.

## INTRODUCTION

Accumulation of carotenoids in the fat produces the yellow colour that can cause rejection of beef in the Japanese market (Morgan and Everitt 1969). Carotenoids are transported in the high density lipoproteins in the blood, and plasma carotenoid (PC) concentrations reflect carotenoid absorption from the diet (Knight *et al.* 1994). A correlation of 0.67 between fat colour and PC concentrations immediately before slaughter suggests indirect selection for fat colour in cattle may be possible using PC concentrations (Morgan and Everitt 1969).

The aim of the trial presented in this paper was to determine if PC concentrations measured early in life could be used to select for fat colour at slaughter in once-bred Hereford x Jersey (HJ) and Hereford x Friesian (HF) heifers.

## MATERIALS AND METHODS

Twenty HJ and 20 HF heifers were mated at Keebles Farm Massey University from November 1992 to January 1993. They calved from August to October 1993 and reared their calves to be weaned in early December. The heifers were bled every 2 months from June 1992 (9-10 months-of-age) to August 1993, and in January and March 1994. The heaviest heifers (12 HF and 10 HJ) in each crossbreed were slaughtered at 31 months-of-age (March 1994), and the rest (8 HF and 10 HJ) were slaughtered at 35 months-of-age (July 1994) after being bled the day before. After being in a chiller for about 24 hours the carcasses were quartered between the 12-13th ribs and the subcutaneous fat colour measured over the 12-13th rib, and the intermuscular fat colour measured at the cut surface of the 12th rib.

Collection and analysis of blood for PC concentration are described by Knight *et al.* (1994). Objective measurements of fat colour were made with a Minolta Chromameter and the c* values (chroma) were calculated using the formula $c^* = \sqrt{a^{*2} + b^{*2}}$. The c* increases as the intensity of the yellow colour of the fat increases.

Data were analysed using GLM procedures (SAS Institute 1987). Analysis of variances were used to compare the traits. Stepwise regression analyses were used to determine the earliest combination of PC concentrations that best predicted the colour of intermuscular and subcutaneous fat after including breed and date of slaughter as factors.

## RESULTS

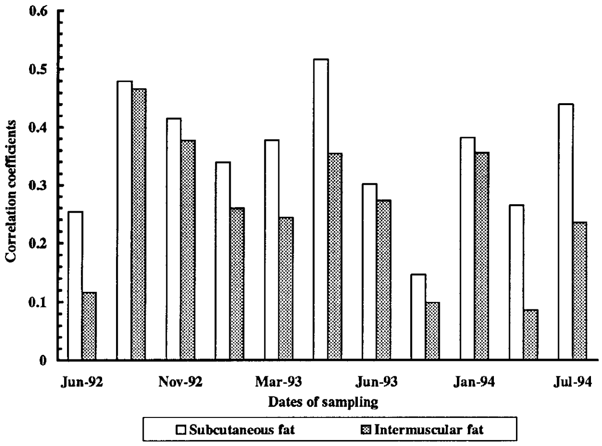
There were no differences in PC concentrations between HF and HJ or between the heavier heifers slaughtered in March 1994 and the lighter heifers slaughtered in July 1994. Despite the lack of differences in PC concentrations, HJ had higher (P<0.05 to P<0.01) c* values for both the subcutaneous and intermuscular fat, and therefore yellower fat, than HF (25.4 ± 0.7 vs 22.7 ( 0.7 for subcutaneous fat c* values and 20.0 ± 0.7 vs 18.0 ± 0.7 for intermuscular fat).

There were significant (P<0.5 to P<0.001) correlations between PC concentrations and c* values for subcutaneous fat on 8 of 11 blood sampling dates, and on 4 dates for intermuscular fat (Fig 1). The earliest significant correlations was when the heifers were 10-12 months-of-age (August 1992). The correlation coefficients for the correlation between c* values for intermuscular fat and PC concentrations were the highest for blood collected in August

[1] AgResearch Grasslands, Private Bag 11008, Palmerston North, New Zealand.
[2] Department of Animal Science, Massey University, Palmerston North, New Zealand.

1992 and for subcutaneous fat the correlation coefficient was only slightly higher for blood collected in May 1993 (Fig 1).

**FIGURE 1:** Correlation coefficients for correlations between PC concentrations in blood samples collected on different dates and the c* values for subcutaneous and intermuscular fat at slaughter.




Regression equations that included breed, date of slaughter and PC concentrations at 10-12 months-of-age accounted for 56% of the variation in c* values for subcutaneous fat and 40% of the variation in c* values for intermuscular fat ($P<0.001$). Including PC concentrations in blood collected in March 1994 marginally improved ($P<0.05$) the prediction of c* values for subcutaneous fat ($r2 = 0.61$) but no additional measures of PC concentrations improved the prediction of c* values for intermuscular fat.

## DISCUSSION

PC concentrations measured on the heifers at about 12 months-of-age gave a better prediction of objectively measured fat colour at slaughter at 31-35 months-of-age than PC concentrations measured closer to the time of slaughter. Earlier work found that PC concentrations measured in the months before slaughter only accounted for 9-16% of the variation in fat colour (Knight unpublished). Morgan and Everitt (1969) by contrast found 45% of the variation in fat colour measured with a tintometer was accounted for by PC concentrations in blood collected at slaughter. These results suggest that within a herd, PC concentration measured early in the life of cattle could be used to identify cattle that would be suitable for finishing for the Japanese market or for selecting cattle for breeding for low fat colour.

The c* values for intermuscular and subcutaneous fat indicate that HJ heifers had yellower fat than HF. Despite this difference in fat colour, there were no differences in PC concentrations. This contrasts with the results of Morgan *et al.*. (1969) who found that both the PC concentrations were higher and the subjectively measured fat colour yellower in Jersey than Friesian steers, with Jersey x Friesian steers being intermediate. Barton and Pleasants (1993) found that 79% of 30 month-old Jersey steers had yellow fat compared to 43% of Friesian steers. While the objectively measured fat colour differences between HF and HJ heifers reported here agrees with the results of earlier workers subjectively measured differences in fat colour, there is no explanation of the failure to find differences in PC concentrations between HJ and HF.

## REFERENCES


Barton, R.A.; Pleasants, A.B. 1993: Fat colour and meat colour in different breeds of steers in five consecutive years raised on pasture and slaughtered at 30 months of age. *Proceedings of the New Zealand Society of Animal Production* **53:** 389-391.

Knight, T.W.; Wyeth, T.K.; Ridland, M.; Death, A.F. 1994: Effects of dietary carotene content on mean values and rankings of heifers for plasma carotene concentrations. *New Zealand Journal of Agricultural Research* **37:** 159-165.

Morgan, J.H.L.; Everitt, G.C. 1969: Yellow fat colour in cattle. *New Zealand Agricultural Science.* July 10-18.

Morgan, J.H.L.; Pickering, F.S.; Everitt, G.C. 1969: Some factors affecting yellow fat colour in cattle. *Proceedings of the New Zealand Society of Animal Production* **29:** 164-175.

SAS Institute Inc 1987: SAS/STAT Guide for personal computers. Version 6 Edition Cary N.C:SAS Institute Inc: SAS/STAT.