# EFFECTS OF GRASS SILAGE, GRAZED GRASS AND A CONCENTRATE DIET ON THE FATTY ACID COMPOSITION OF BEEF SUBCUTANEOUS FAT

**J.D Wood*[1], H.E. Warren[3], G.G Stonehouse[1], K.G. Hallett[1], F.M. Whittington[1], N.D. Scollan[2] and R.I. Richardson[1]**

*[1] Division of Farm Animal Science, School of Veterinary Science, University of Bristol, Langford, Bristol, BS40 5DU, UK. [2] Institute of Grassland and Environmental Research, Aberystwyth, Wales, SY23 3EB, UK. [3] Nottingham Trent University, Southwell ,Notts ,NG25 0QF, UK. Email: Jeff.Wood@bristol.ac.uk*

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## Introduction

Fatty acid composition is of major importance in the healthiness of meat, especially in the ruminant species cattle and sheep, which have relatively saturated fat. However, ruminants deposit significant amounts of 'beneficial' fatty acids in meat, particularly the n-3 (omega-3) polyunsaturated fatty acids (PUFA) and conjugated linoleic acid (CLA, 18:2-9c 11t).

Diet is a major factor in ruminant meat fatty acid composition, with grass-based diets increasing levels of α-linolenic acid (18:3n-3) and the longer-chain n-3 PUFA. Grass, however, is a variable feed stuff, according to the time of year and whether it is fed fresh or conserved as silage or hay. In this work, we contrast fresh grazed grass, grass conserved as silage and a standard concentrate in terms of their effects on the fatty acid composition of subcutaneous fat in beef steers.

## Materials and Methods

Twenty-four steers from each of two breeds, Holstein-Friesian (HF) and Aberdeen Angus x Holstein-Friesian (AA) were used in this study, part of a bigger study into the effects of age, breed and diet on fatty acid composition and meat quality in beef (Warren *et al.*, 2006). From 6 months of age, 8 steers from each breed were fed either a concentrated diet (based on barley and full fat soyabean meal) or a grass silage diet and reared to 19 months so that the growth rate of these two groups was similar. A third group of 8 steers from each breed was fed grass silage from 6 to 12 months then grazed fresh grass from 12 to 19 months during the Spring and Summer. Fresh and conserved grass was perennial ryegrass. At 19 months the cattle were slaughtered and samples of subcutaneous fat were removed from the loin region. Lipids were extracted into chloroform and hydrolysed with 2M KOH in methanol containing an internal standard, C21:0. Fatty acids were extracted into petroleum ether and methylated with diazomethane. They were then analysed by gas liquid chromatography (GLC).

Breed affected the results for weight and carcass composition but fatty acid composition was overwhelmingly influenced by diet so only the results for diets (breeds pooled) are presented.

## Results and Discussion

Results for live weight and carcass characteristics are in Table 1. Steers fed occentrate and grass silage were similar in weight as intended, although AA were slightly heavier than HF. The groups fed fresh grass were lighter, with no difference between breeds. The animals fed grass silage were fatter than those fed concentrate, with the fresh grass group being the least fat. AA were fatter than HF.

**Table 1:** Live weight and carcass fat cover.

| | Concentrate | | Grass silage | | Fresh grass | | SED | | Sig |
|---|---|---|---|---|---|---|---|---|---|
| | AA | HF | AA | HF | AA | HF | | | |
| Final live weight (kg) | 519 | 501 | 526 | 492 | 467 | 473 | 14.9 | ns | *** |
| Fat score[1] | 71 | 30 | 113 | 74 | 52 | 32 | 7.5 | * | * |

[1] Estimated subcutaneous fat % x 10. Score ( 20-145) given by carcass assessor.

The results for the fatty acid composition of subcutaneous fat are in Table 2. The proportion of linoleic acid (18:2n-6), which is the major fatty acid in grain and soya, was 2.5 times higher in the concentrate group. The proportion of 18:3n-3 was about 3 times higher in the fresh grass and grass silage groups than in concentrates and was significantly higher in thefresh grass than in the grass silage group. These results for 18:2n-6 and 18:3n-3 reflect differences in the composition of the diets. The proportion of trans vaccenic acid (18:1trans) was about 2.8 times higher in concentrate and fresh grass than grass silage. CLA followed the same pattern, being about two times higher in Concentrate and the fresh grass than Grass silage. The relationship between 18:1trans and CLA is shown in Figure 1. The linear relationship between the proportions of these two fatty acids reflects the production of CLA from 18:1trans, most of which occurs in adipose tissue in cattle (Tanaka, 2005). The implication is that rumen fermentation of the concentrate

and the fresh grass diets resulted in similar amounts of 18:1trans production in the rumen which was absorbed from the blood stream and synthesised into CLA in adipose tissue. The pattern of ruminal fermentation of grass silage was apparently different from that of fresh grass, as has been shown previously (Schmid, *et al.*, 2006). This led to a much smaller production of 18:1 trans and also stearic acid (18:0), the main product of complete biohydrogenation of 18C PUFA.

**Table 2:** Fatty acid composition of subcutaneous fat (%).

| | Concentrate | Fresh grass | Grass silage | SED | Sig. |
|---|---|---|---|---|---|
| C12:0 | 0.12[c] | 0.08[a] | 0.09[b] | 0.007 | *** |
| C14:0 | 3.86[a] | 3.46[a] | 4.51[b] | 0.214 | *** |
| C16:0 | 26.20[b] | 24.76[a] | 28.89[c] | 0.649 | *** |
| C16:1 | 5.26[a] | 5.79[b] | 7.15[c] | 0.372 | *** |
| C18:0 | 14.04[b] | 15.20[b] | 10.09[a] | 1.069 | *** |
| C18:1tr | 4.07[b] | 4.32[b] | 1.48[a] | 0.272 | *** |
| C18:1cis9 | 31.17 | 32.06 | 32.83 | 0.909 | ns |
| C18:1cis11 | 1.08[b] | 0.86[a] | 1.03[b] | 0.062 | ** |
| C18:2 | 2.39[b] | 0.97[a] | 0.90[a] | 0.067 | *** |
| CLA,9c11t | 0.95[b] | 0.93[b] | 0.43[a] | 0.052 | *** |
| C18:3 | 0.22[a] | 0.68[c] | 0.59[b] | 0.024 | *** |

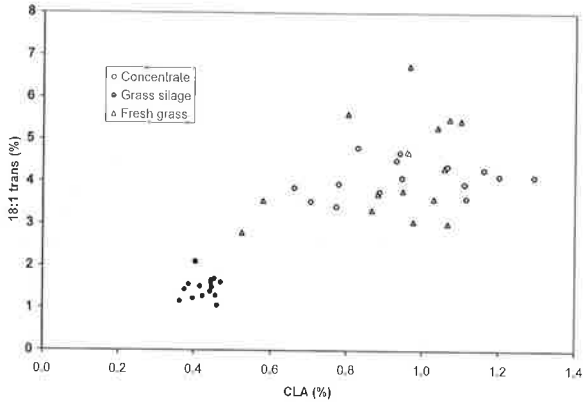


**Figure 1:** Relationship between 18:1 trans (%) and CLA (%). Linear regression : y=4.27x, $r^2$=0.67.

## Conclusions

Feeding fresh grass (grazing), grass silage and concentrate to beef cattle resulted in different fatty acid profiles in subcutaneous fat. Compared with grass silage, fresh grass produced higher proportions of 18:3 n-3, 18:1 trans and CLA and also a higher proportion of 18:0. The concentrate diet produced more 18:2 n-6 and similar proportions of 18:1 trans and CLA as fresh grass.

## References

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