TEMPORAL CHANGE IN THE CARBON STABLE ISOTOPE RATIOS OF BEEF FOLLOWING A CHANGE IN RATION COMPOSITION

F.J. Monahan*[1], O. Schmidt[2], A.P. Moloney[3], P.G. Dunne[3], C.M. Scrimgeour[4] and I.S. Begley[5]

[1] UCD School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Dublin 4, Ireland, [2] UCD School of Biology and Environmental Science, University College Dublin, Dublin 4, Ireland, [3] Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland, [4] Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, United Kingdom, [5] Iso-Analytical Ltd., Unit 2, Zan Industrial Park, Sandbach, Cheshire CW11 4QD, United Kingdom.
Email: frank.monahan@ucd.ie

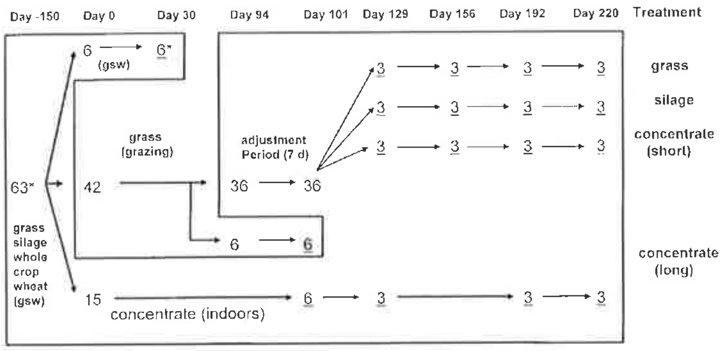
Keywords: beef, dietary history, stable isotopes

Introduction

Information concerning the production and origin of foods of animal origin is increasingly sought by consumers. In particular, guarantees of food authenticity and traceability, with appropriate labelling, are required. There is therefore a need to develop methodologies capable of providing information about the origin of animal-derived foods. On-going research aims to establish whether the isotopic composition of light elements ($\delta^{13}C$, $\delta^{15}N$, δ D, $\delta\ ^{18}O$ and $\delta^{34}S$) can be used as an intrinsic, biochemical marker tool for tracing and authenticating beef (Kelly et al., 2005). The specific objectives of the experiments conducted in Ireland were 1) to determine the temporal variability in the stable isotope composition of C ($\delta^{13}C$) in feed materials over one growing season, and 2) to determine the speed at which temporal changes in the isotopic composition of beef muscle tissue occur following a change in diet.

Materials and Methods

From a group of 63 heifers, 15 were fed concentrates for 220 days and 36 were grazed for 97 days, then housed and offered in groups of 12 one of three diets differing in the proportion of concentrates, silage and grass (Figure 1). Heifers were slaughtered at approximately monthly intervals (n=3 per date per diet) and feed samples were collected regularly from June to November. Two control groups (n=6) were slaughtered at day 30 and day 101 (see Figure 1). Samples of the striploin (*M. longissimus dorsi*) were collected, freeze-dried and milled. The $\delta^{13}C$ of bulk muscle and bulk feed materials was determined by Isotope Ratio Mass Spectrometry.



Boxed area indicates animals housed indoors. *number of animals, underline indicates animal slaughter

Figure 1: Experimental design.

Results and Discussion

The isotopic composition of the concentrate and grass silage showed little temporal variation (range <0.6‰ $\delta^{13}C$) over a 5-month period. Grass, by contrast, showed marked temporal trends over this period with monthly values ranging from −29.6 to −31.0‰ in $\delta^{13}C$. There was an isotopic difference (about 3‰ $\delta^{13}C$) between concentrate and grass/grass silage feed materials (Figure 2).

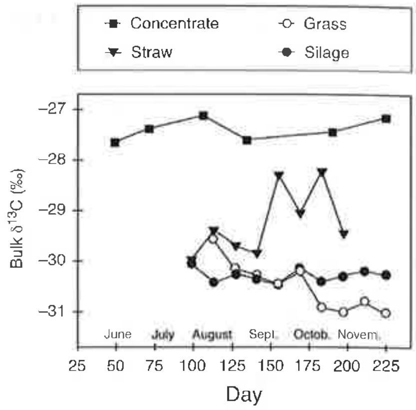


Figure 2: Isotopic composition of feed materials.

The isotopic composition of muscle tissue changed only slowly after diets were switched. However, even small isotopic differences between grass- and concentrate-based diets were consistently reflected in bulk muscle tissue (Figure 3). The final difference in muscle $\delta^{13}C$ between the grass and 'long concentrate' treatments was 1.9‰.

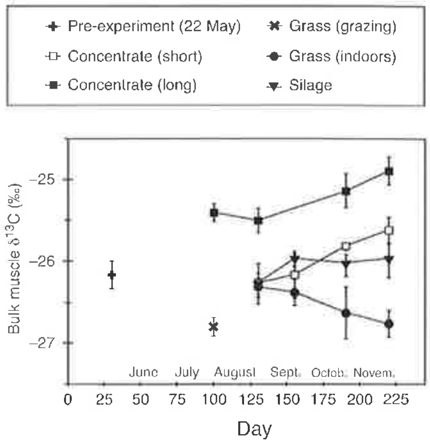


Figure 3: Isotopic composition of muscle tissue.

Conclusions

1) While $\delta^{13}C$ showed little temporal variation in concentrate and silage feed materials, it was more variable in fresh grass over one growing season.

2) Bulk muscle tissue reflected small isotopic differences between dietary components after about 100 days.

References

Kelly, S., Heaton, K and Hoogewerf, J. Tracing the geographical origin of food: the application of multielement and multi-isotope analysis. Trends in Food Science and Technology, 16, 555-567 (2005).

Schmidt, O., Quilter, J.M., Bahar, B., Moloney, A.P., Scrimgeour, C.M., Begley, I.S. and Monahan, F.J. Inferring the origin and dietary history of beef from C, N and S stable isotope ratio analysis. Food Chemistry, 91, 545-549. (2005).