**The effect of a biodiverse pasture on the nutritional quality of lamb meat**

**Application:** Biodiverse pastures offer a sustainable source of forage for grazing ruminants, but little is known about whether these pastures affect meat nutritional quality. This study reported beneficial effects on nutritional quality of meat from lambs grazing biodiverse vs perennial ryegrass pasture; as such biodiverse pastures should be considered for incorporation into grazing systems.

**Introduction:** Within temperate regions the use of monoculture perennial ryegrass (PRG; *Lolium perenne*) for lowland sheep production systems is widespread. However, PRG requires a high input of inorganic nitrogen, and has lower resilience than biodiverse pastures (Hofer *et al*., 2016), which are considered a sustainable alternative. The impact of biodiverse pastures on animal growth and productivity is inconsistent (Kliem *et al*., 2018; Grace *et al*., 2019), and the effect on meat nutritional quality is undefined although previous research suggests that the fatty acid (FA) profile could be improved via higher polyunsaturated FA content (Kliem *et al*., 2018). Also, the presence of deep-rooting forage herbs in biodiverse swards could improve the trace mineral supply to the grazing animal. The main objective of this study was to investigate the effect of a biodiverse pasture containing 12 different plant species (BP) on lamb growth and meat nutritional quality, when compared with a PRG monoculture.

**Materials and methods:** Thirty mule male castrated lambs (mean weight 29.3 kg ± 0.63 SEM) were grazed for 19 weeks on either a PRG or BP pasture (BP comprising of perennial ryegrass, cocksfoot, festulolium, meadow fescue, red, white and alsike clover, black medick, lucerne, plantain and chicory; n=15 lambs per plot). Lambs were weighed weekly, and body condition scored (BCS) from week 6 onwards. Samples of above ground biomass were collected at the beginning, middle and end of the study, and were dried and milled prior to proximate, FA (Juniper *et al*., 2022) and selenium (Enamorado-Baez *et al*., 2013) analysis. After reaching the target weight (45 kg) lambs were humanely slaughtered, and tissue samples were taken from *musculus longissimus thoracis*. Tissue was separated into lean and subcutaneous fat prior to homogenisation. Samples were then analysed for FA (Juniper *et al*., 2022), and lean tissue for trace minerals (iron, selenium, zinc; Enamorado-Baez *et al*., 2013) and thiobarbituric acid reactive substances (TBARS; Juniper *et al*., 2022). Pasture composition data was analysed using a two-sample t-test for effects of treatment. Weekly liveweight gain was analysed using an ANOVA MIXED model including fixed effects of treatment, week and random effect of lamb, and meat composition data was analysed using an ANOVA MIXED model with fixed effect of treatment and random effect of lamb.

**Results:** There was little difference between nutritional quality of pastures, apart from BP having a higher (*P*<0.001) selenium and 18:2 n-6 content, and a tendency for higher ADF (*P*<0.1). Weekly liveweight gain was higher (*P*=0.017) for PRG than BP (1.34 vs 1.11 kg/week), but there was no overall effect (*P*=0.174) of pasture treatment on BCS. Lean and subcutaneous fat tissue from BP lambs contained more (*P*<0.05) 18:2 n-6 (Table 1) and zinc (68.6 vs 61.8 ug/kg dry tissue) than lean and subcutaneous fat from PRG lambs. There was no effect (*P*>0.05) of pasture on other meat FA (Table 1), trace minerals or TBARS.

**Conclusions:** Grazing lambs on a sustainable biodiverse pasture for 19 weeks marginally improved the nutritional quality *m. l. thoracis* meat, due to higher 18:2 n-6 content (without a concomitant increase in TBARS), and zinc concentrations. Further research should focus on including specific plant species in biodiverse pasture to improve nutritional quality of ruminant meat, whilst maintaining pasture resilience and sustainability.

**Acknowledgements:** This study was funded by the University of Reading Research Endowment Trust Fund. We would like to acknowledge technical staff at the Centre for Dairy Research for animal care, and at the University of Reading for assistance with nutrient analysis.

**Table 1**. Effect of grazing lambs on either a perennial ryegrass monoculture or a biodiverse pasture (12 species mix), on selected fatty acid and trace mineral contents of lean and subcutaneous fat from *musculus longissimus thoracis* (mg/100 g tissue).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Pasture type1 |  |  |
|  | PRG | BP | SEM | *P*2 Treatment |
| *M. longissimus thoracis* |  |  |  |  |
|  16:0 | 2458 | 2591 | 184.6 | 0.608 |
|  18:0 | 2715 | 2762 | 219.4 | 0.880 |
|  18:1 *cis*-9 | 2935 | 2987 | 240.5 | 0.876 |
|  18:1 *trans*-11 | 448 | 489 | 33.4 | 0.380 |
|  18:2 *cis*-9, *cis*-12 | 187 | 233 | 15.1 | 0.037 |
|  18:3 n-3 | 127 | 138 | 11.2 | 0.492 |
|  Total PUFA3 | 561 | 596 | 38.2 | 0.517 |
|  VLC4 n-3 | 59.0 | 57.0 | 4.64 | 0.765 |
|  Total lipid | 10268 | 10639 | 749.2 | 0.724 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subcutaneous fat |  |  |  |  |
|  16:0 | 18993 | 18715 | 659.0 | 0.756 |
|  18:0 | 21135 | 21002 | 886.1 | 0.912 |
|  18:1 *cis*-9 | 22393 | 20663 | 775.7 | 0.109 |
|  18:1 *trans*-11 | 4298 | 4403 | 311.0 | 0.802 |
|  18:2 *cis*-9, *cis*-12 | 817 | 945 | 36.4 | 0.014 |
|  18:3 n-3 | 760 | 813 | 43.5 | 0.371 |
|  Total PUFA3 | 2909 | 2742 | 130.6 | 0.349 |
|  VLC4 n-3 | 136 | 122 | 12.2 | 0.392 |
|  Total lipid | 78902 | 76555 | 2000.1 | 0.390 |

1PRG – perennial ryegrass, BP – biodiverse.

2Significance of the effect of pasture treatment for n=15 lambs

3Polyunsaturated fatty acids

4Very long chain n-3 polyunsaturated fatty acids

**References:**

Enamorado-Baez, S.M., Abril, J.M., Gomez-Guzman, J.M. 2013. ISRN Analytical Chemistry DOI:10.1155/2013/851713.

Grace, C., Lynch, M.B., Sheridan, H., Lott, S., Fritch, R., Boland, T.M., 2019. Animal, 13, 1721-1729.

Hofer, D., Suter, M., Haughey, E., Finn, J.A., Hoekstra, N.J., Buchmann, N., Lüscher, A., 2016. Journal of Applied Ecology, 53, 1023-1034.

Juniper, D.T., Kliem, K.E., Lee, A., Rymer, C., 2022. Animal, 16, doi: 10.1016/j.animal.2022.100459.

Kliem, K.E., Thomson, A.L., Crompton, L.A., Givens, D.I., 2018. Animal, 12, 2415-2423.