**Application** Making increased use of low-human-edible feeds in dairy rations can contribute to the development of more sustainable milk production systems.

**Introduction** The current study examined milk production and feed efficiency responses of dairy cows offered concentrates differing in human-edible fraction (HEF).

**Materials and Methods** A three-period partial changeover design experiment using 32 early lactation dairy cows (mean of 50 days calved) examined the effects of offering four concentrates differing in HEF (proportionately 0.17, 0.28, 0.38 and 0.48 on a fresh basis; 0.17HE, 0.28HE, 0.38HE and 0.48HE respectively) with a grass silage based diet. The latter treatment most closely represented a “conventional dairy cow diet”. Cows were offered 12 kg/day of their treatment concentrate via two out-of-parlour feeding stations. Two iso-energetic and iso-nitrogenous concentrate types were produced (0.17HE and 0.48 HE) and blended in different proportions through the stations to achieve the 0.28HE and 0.38HE treatments. The 0.48HE concentrate was based on cereals and soya-bean meal, while these ingredients were replaced with by-product feeds like sugar beet pulp and distillers dark grains in 0.17HE concentrate. The HEF of the diets were calculated as described by Wilkinson (2011). The forage component comprised grass silage and rotagrind straw (latter at 3.5% dry matter, (DM)), which was mixed in a diet-feeder before being offered to the cows. Cows also received 0.25 kg of a commercial concentrate at each milking. Feed intake, milk yield and milk composition was recorded during the fourth week of each period. Feed conversion rate (FCR) was calculated as energy corrected milk yield (ECM) per kg DM intake (DMI). Edible feed conversion rate (eFCR) was calculated as human-edible output divided by human-edible input per day. Net Food Production (NFP) was expressed as daily human-edible output minus daily human-edible input using HEF values described by Ertl et al. (2015) under current standard extraction allowances. Data was analysed using linear mixed model methodology (REML) with Cow and Period as a fixed effect. Linear and quadratic effects of treatment level were examined using polynomial contrasts.

**Results** The silage had a DM, crude protein (CP) and lactic acid concentration and D-value of 283 g/kg, 157 g/kg DM, 121 g/kg DM and 711 g/kg DM respectively. Increasing the HEF of the concentrate tended to increase total DM intake (P=0.067, Lin) but reduced ECM yield (P<0.001, Lin.). Milk fat and protein concentration was unaffected by changes in HEF in the concentrate. However increasing the HEF reduced the concentration of total poly-unsaturated acids (PUFA) and conjugated linolenic acid (CLA) (P<0.001, Lin.) and reduced FCR, eFCR and NFP (P<0.001, Lin.).

Table 1. Performance of cows offered concentrates with differing levels of human-edible ingredients

|  |  |  |  |
| --- | --- | --- | --- |
|  |  Treatment |  |  P-value |
|  | 0.17HE | 0.28HE | 0.38HE | 0.48HE | SED | Treat. | Lin. | Quad. |
| Total DMI (kg/day) | 23.2 | 23.6 | 23.8 | 23.8 | 0.28 | 0.205 | 0.067 | 0.297 |
| ECM yield (kg/day) | 39.0 | 37.7 | 37.0 | 36.1 | 0.73 | 0.002 | <0.001 | 0.749 |
| Milk fat (g/kg) | 44.9 | 44.6 | 45.5 | 45.6 | 0.90 | 0.645 | 0.300 | 0.725 |
| Milk fatty acid concentration (g/100 g total fatty acids) |
| Total PUFA  | 2.4 | 2.4 | 2.3 | 2.2 | 0.04 | 0.003 | <0.001 | 0.278 |
| CLA  | 0.53 | 0.50 | 0.46 | 0.39 | 0.036 | 0.001 | <0.001 | 0.407 |
| Milk protein (g/kg) | 32.4 | 32.5 | 32.6 | 32.9 | 0.35 | 0.822 | 0.957 | 0.394 |
| FCR | 1.68 | 1.60 | 1.54 | 1.52 | 0.033 | <0.001 | <0.001 | 0.314 |
| eFCR (energy) | 3.57 | 2.22 | 1.59 | 1.23 | 0.016 | <0.001 | <0.001 | 0.626 |
| NFP(Protein)(g/day) | 815 | 609 | 412 | 209 | 26.0 | <0.001 | <0.001 | 0.925 |

**Conclusions** Increasing the HEF of the concentrate offered to dairy cows resulted in a reduction in milk yield and eFCR.

**Acknowledgements** This project was funded by Department of Agriculture, Environment and Rural Affairs (DAERA).

**References**

Ertl, P., Klocker, H., Hortenhuber, S., Knaus, W. and Zollitsch, W. (2015). Agricultural Systems, 137: 119-125.

Wilkinson, J.M. (2011). Animal, 5: 1014-1022 .