Project title: **The potential implications of precision feeding techniques in beef cattle production systems**

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Project overview:

Precision feeding aims to account for variations in the nutrient requirements of farm animals, thereby increasing the efficiency of nutrient utilisation and optimising animal performance. There is subsequently a need to determine if precision livestock feeding techniques can be used to improve the efficiency of feed utilisation and reduce the environmental impact of growing and finishing beef cattle production systems. Historically, performance data has been collected at Harper Adams University relating to Aberdeen-Angus x Holstein cattle fed a grass silage-based growing diet, and British Blue x Holstein steers fed either a concentrate- or forage (Whole crop wheat)-based finishing diet. Data from these experiments was subsequently used to investigate the implications of adopting precision feeding in growing and finishing beef cattle production systems within two scenarios. Under **Scenario A** (Commercial practice), the original diets were formulated using predicted animal performance as a nutritionist would on farm. Whereas, under **Scenario B** (Matched feeding), the original study diets were reformulated to optimise nutrient supply according to recorded animal performance at a group level observed during the experiments. The recorded physical parameters that were introduced under the latter scenario at a group level included: dry matter intake, liveweight, and average daily gain. Results relating to animal performance, nutrient supply, and emissions intensity, were presented in relation to predicted performance (**Scenario A**), performance that was actually recorded on the study as a result of feeding the **Scenario A** diet (**Recorded performance**), and dietary reformulation as a result of actual performance (**Scenario B**; Table 1).

Research Outcomes:

1. Overall, the resulting story is very much one of protein oversupply in traditional UK beef cattle diets. All of the growing and finishing cattle diets in this study were formulated according to target commercial crude protein recommendations of 14% DM. Indeed, whenever these diets are fed in practice (**Recorded performance**), there was an observed range in metabolisable protein (MP) oversupply of 176 % (as a % of requirements) down to 140 % across all of the various beef cattle diets respectively.
2. Under **scenario B**, diets were reformulated to sustain the same level of animal performance, but dietary protein concentrations were decreased in line with animal requirements. In both growing and finishing diets, this resulted in the replacement of rapeseed meal and wheat distillers' dark grains with barley. Despite the removal of all bought-in protein sources in all of the diets, MP supply still exceeded animal requirements in all instances. However, crude protein concentrations were observed to decrease from a mean of 14.1 % DM across all of the diets under **scenario A**, to 10.8 % DM (Range: 9.4-12.2 % in the DM) under **scenario B** respectively.
3. The decreased inclusion of bought-in protein sources under **scenario B** was reflected in a subsequent decrease in both diet costs, and emissions intensity of feed provision, which decreased by a mean of 0.20 £/kg of average daily gain (Range: 0.31-0.10 £/kg), and 11.1 % (Range: 18.0-7.0 %) across all of the growing and finishing cattle diets respectively.

Practical application / Sector use:

A large proportion of the beef sector still relies upon CP during diet formulation, and a move to the MP system coupled with more accurate prediction of animal intake from on-farm monitoring, has the potential to decrease reliance upon bought-in protein sources, and decrease system emissions intensity.

Table 1. Effect of matched feeding on the performance, nutrient balance, and emissions intensity of Aberdeen Angus cross Holstein steers during the housed growing phase.

	Steers		
	Scenario A	**Recorded performance**	**Scenario B**
Initial live weight, kg	387	387	
Final live weight, kg	461	497	
Mean live weight, kg	424	442	
Housed period, days	70	70	
ADG[1], kg/d	1.05	1.56	
Dry matter intake, kg/d	8.86	11.09	
Feed conversion ratio, kg/kg	8.44	7.09	
MP[2] requirement, g/d	459	561	561
MP supply, g/d	630	789	601
MP supply as a % of requirements	133	140	107
Diet cost, £/T of DM	165.64	165.64	137.27
Diet cost, £/kg of ADG	1.40	1.18	0.98
Emissions intensity, kgCO_2-eq/kg of ADG			
Feed	4.88	4.11	3.69
Enteric	4.53	3.82	3.82
Manure and bedding	5.85	3.94	3.94
Total	15.27	11.87	11.45

[1] Average daily gain

[2] Metabolisable protein