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Characterisation of the feeding value of imported by-product feedstuffs for beef cattle

Key external stakeholders:
Beef farmers, ruminant feed manufacturers, beef industry, animal feed technical advisors, Teagasc advisory service, agri-consultants, scientific community

Practical implications for stakeholders:
Concentrates are a key component of beef production systems, especially during the indoor winter period and feeding of finishing cattle.

- The relative feeding (and economic) value of by-product feed ingredients depends on their inclusion level in the concentrate ration, and the amount of concentrates fed.
- If cattle are slaughtered at the same carcass weight/fatness the composition of the concentrate ration does not greatly influence beef eating quality.

Main results:

- Interactions or 'associative effects' between grass silage and concentrate feed ingredients have consequences for feed utilisation and thus, the nutritive value assigned to by-product feed ingredients.
- The relative feeding (and economic value) of by-product feed ingredients is contingent on concentrate feeding practices.
- Meat eating quality was generally similar across the ingredients tested; namely, *barley/soya bean meal, corn gluten feed, citrus pulp, maize dried distillers grains* and *wheat dried distillers grains*.

Opportunity / Benefit:

Beef farmers, and the animal feed industry, have the opportunity to utilise alternative (and possibly more cost-effective) feed ingredients as supplements to grass silage.

Collaborating Institutions:

UCD, UCC and University of Catania, Italy

Teagasc project team:
Dr. Mark McGee (PI)
Dr. Aidan Moloney
Dr. Edward O'Riordan
David Magee (Walsh Fellow)
Michael Kelly (Walsh Fellow)
Eddie Mulligan (Research Technician)

External collaborators:
Dr. Alan Kelly, UCD
Dr. Michael O'Grady & Dr. Joseph Kerry, UCC
Saheed Salami (Post-graduate)
Dr. Giuseppe Luciano & Dr. Alessandro Priolo, University of Catania, Italy

Contact Mark McGee Email: mark.mcgee@teagasc.ie

1. Project background:

Feeding concentrates is a key component of beef production systems, especially during the indoor winter period and the finishing period. Energy is the most important component of the ration required by growing-finishing cattle. The deficiencies in nutrient supply from forages are usually overcome by supplementing with concentrates. In addition to cereals, a wide variety of feed ingredients is available which may be included in beef rations and offered to cattle in varying amounts. Winter feed costs could be reduced through utilisation of alternative, more cost-effective feed ingredients.

Ireland is a deficit country in the production of native cereals and proteins for animal feed, and accordingly production must be supplemented through the importation of feed ingredients. By-product feeds, also known as co-products, are secondary products mainly from the food processing industry and the biofuel/ethanol industry. By-products generally have little value as a foodstuff for humans, but many are suitable as a feed for cattle due to the ability of cattle to digest fibrous, plant cell-wall material. However, a potential limitation of feeding by-products to cattle is that significant variation can exist in their chemical composition and nutrient content, and this is liable to change over time as the primary manufacturing processes evolve and become more efficient. This means that periodic re-evaluation of the nutritive and feeding value of by-products is required for accurate formulation of rations for beef cattle. In addition to animal intake and growth performance, knowledge of the effect of ration composition on the eating quality of beef is paramount in ensuring its continued purchase by the consumer.

2. Questions addressed by the project:

- What is the feeding value of the most common by-product ingredients when incorporated in beef cattle rations in terms of animal intake, growth, efficiency and carcass traits?
- What impact has concentrate ration ingredient composition on beef meat eating quality?

3. The experimental studies:

A series of experiments was carried out at Teagasc Grange, to evaluate a number of key by-product feed ingredients in beef cattle diets. The 'control' concentrate offered in all these studies was a barley/soya bean meal-based ration (ca. 862g rolled barley, 60g soya bean meal, 50g molasses, 28g minerals and vitamins/kg); all other rations were compared against this. The optimum inclusion level of a number of by-product feeds was evaluated by replacing rolled barley and some, or all, of the soya bean meal (depending on the protein content of the test feed ingredient) in the ration. All concentrate rations were prepared as coarse mixtures. Rations were offered to 'growing' and/or 'finishing' cattle as supplements to grass silage or *ad libitum* with restricted grass silage.

4. Main results:

Concentrate supplementation of grass silage for 'weanling' cattle

For growing 'weanling' cattle, *soya hulls* and *citrus pulp* can replace rolled barley in concentrate rations when offered at relatively low levels (ca. 2 kg/day), as a supplement to high-digestibility (DMD ~70%+) grass silage, without negatively affecting performance.

Concentrate feeds for growing-finishing cattle

- For finishing cattle diets, *citrus pulp* can replace rolled barley in the ration up to 400g/kg without negatively affecting performance when offered at ca. 5.0 kg concentrate per day as a supplement to high-digestibility grass silage.
- For growing cattle offered ca. 3.5 kg/day of concentrate as a supplement to moderate-digestibility (DMD ~65%) grass silage, and finishing cattle offered *ad libitum* concentrates, the optimum inclusion level of *soya hulls* in a barley-based concentrate was ca. 200 g/kg.
- *Dried corn gluten feed* had a feeding value comparable to that of rolled barley/soya bean meal when offered as a supplement (ca. 5.0 kg/day) to high-digestibility grass silage.
- *Maize dried distillers grains* plus solubles had a superior feeding value (based on dietary feed conversion ratio) to *wheat dried distillers grains* plus solubles when the ration was offered as a supplement (3.5 kg/day) to grass silage or *ad libitum*. The optimal inclusion level of maize and wheat dried distillers grains in the concentrate was about 800 g/kg when the concentrate ration was offered as a supplement to moderate-digestibility grass silage and, about 400 g/kg for maize, and 200g/kg for wheat, dried distillers when the ration was offered *ad libitum*.
- *Palm kernel expeller meal* can be included in a barley-based concentrate at up to 400 g/kg when offered as a supplement to moderate digestibility grass silage and up to 100 g/kg when offered *ad libitum*.

Overall, the relative nutritive (and economic) value of by-product feed ingredients depends on their inclusion level in the concentrate ration, and the amount of concentrates fed. These findings imply that interactions or 'associative effects' between grass silage and concentrate feed ingredients have consequences for feed utilisation and thus, the nutritive value assigned to by-product feed ingredients. This means that the relative

Contact Mark McGee Email: mark.mcgee@teagasc.ie

economic value of by-product feed ingredients is contingent on concentrate feeding practices.

Effect of concentrate feed ingredients on meat eating quality

Eating quality of meat from steers offered grass silage supplemented with 4 kg/day concentrate ration containing different feed ingredients namely; *barley/soya bean*, *corn gluten feed*, *citrus pulp*, *maize dried distillers grains* and *wheat dried distillers grains*, was generally similar. There were some differences in "fishy flavour" but the values were very low for all ingredients. In general therefore, if slaughtered at the same carcass weight/fatness, the composition of the diet does not greatly influence beef eating quality. This means that farmers therefore can choose the most cost-effective ingredients without compromising meat eating quality when compared to a barley/soya bean ration offered as a supplement to grass silage.

5. Opportunity/Benefit:

Beef farmers, and the animal feed industry, have the opportunity to source alternative (cost-effective) feed ingredients as supplements to grass silage.

6. Dissemination:

M.Agr.Sc. Theses; Teagasc National Beef Conference 2017; ASA 'Beef Nutrition Masterclass' 2016; Society of Feed Technologists 2016; IGFA Technical meeting 2015; Teagasc Beef Advisory Newsletters; Teagasc In-service Training; FETAC / QQI Ruminant Nutrition courses; Lectures/seminars.

Main publications:

Kelly, M., Moloney, A.P., Kelly, A. and McGee, M. (2018) 'Intake, growth, carcass and selected meat quality traits of steers offered grass silage and supplementary concentrates with increasing levels of dried corn gluten feed' *Advances in Animal Biosciences* 9: (1), 150.

Lenehan, C., Moloney, A.P., O'Riordan, E.G., Kelly, A. and McGee, M. (2017) 'Comparison of rolled barley with citrus pulp as a supplement for growing cattle offered grass silage' *Advances in Animal Biosciences* 8: s1, 33-37.

Magee, D., Moloney, A.P., Kelly, A., O'Riordan, E.G. and McGee, M. (2015) 'Replacement of barley with increasing levels of maize dried distillers grains: intake, growth and carcass characteristics of beef cattle' *Proceedings of the Agricultural Research Forum*, Tullamore, p80.

Popular publications:

McGee, M., O'Riordan, E. and Moloney, A. (2018) 'Concentrate feeding and feed ingredients for growing-finishing cattle' In: *BEEF 2018*, '€nhancing Knowledge', Tuesday, 26th June 2018, Teagasc, Grange, Dunsany, Co. Meath, p152-155. Eds. M. McGee and A. Moloney, ISBN: 978-1-84170-646-7.

Moloney, A., McGee, M., O'Riordan, E., O'Sullivan, E. and Kerry, J. (2018) 'On-farm influences on the eating quality of beef'. In: *BEEF 2018*, '€nhancing Knowledge', Tuesday, 26th June 2018, Teagasc, Grange, Dunsany, Co. Meath, p164-167. Eds. M. McGee and A. Moloney, ISBN: 978-1-84170-646-7.

McGee, M., O'Riordan, E. and Moloney, A. (2017) 'Concentrate feed ingredients for growing-finishing cattle. In: 'Planning for Healthy profits', *Teagasc National Beef Conference*, 17 October, Tullamore, Co. Offaly. 32-39.

McGee, M., O'Riordan, E. and Moloney, A. (2016) 'Concentrate feeding for beef cattle' *TResearch* 11: (2) Summer 2016, 26-27.

7. Compiled by: Dr Mark McGee and Dr Aidan Moloney

Contact Mark McGee Email: mark.mcgee@teagasc.ie