Concentrate feed ingredients for growing-finishing cattle

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Teagasc National Beef Conference 2017
Introduction

- Beef production: Conversion of feed to animal product as (cost) efficiently as possible.

- Feed provision: Single largest variable cost in beef production.
Total feed costs – energy basis

Source: Finneran et al. 2013
Annual Feed Budgets (/cow unit)

Suckler calf-to-beef system: 24 mth steer

Dry Matter Intake
- Grazed grass: 65%
- Grass silage: 27%
- Concentrates: 8%

€
(incl. land charge)
- Grazed grass: 44%
- Grass silage: 39%
- Concentrates: 17%
Concentrate feed ingredients

- **Beef rations:** Cereals + a wide variety of feed ingredients used
- **By-product feeds:**
  - Secondary products - food processing & biofuel / ethanol industry.
- **More cost-efficient animal performance** via utilisation of alternative feed ingredients?

**HOWEVER,** potential limitation with by-products:

- **Significant variation:** chemical composition & nutrient content
- **Liable to change over time.**
  - Periodic re-evaluation of nutritive value required

- **DAFM-funded Research:** “Feed Evaluation for Accurate Nutrition” (FEFAN)
  - Beef cattle experiments @ Grange
  - Revised ‘Feed Tables’
Overall objective

• Examine effects of replacing rolled Barley with different feed ingredients (@ various inclusion levels) in a concentrate ration on intake and performance of beef cattle

• Citrus pulp (25-155K t)
• Soya hulls (230-440K t)
• Palm kernel expeller meal (110-220K t)
• Corn gluten feed (275-400K t)
• Maize dried distillers grains (270-400K t)
• Wheat dried distillers grains
• Maize grain
Experimental approach

- **Concentrates:** Coarse rations
  - ‘Control’ = BAR: ~86% rolled barley,
    6% soyabean meal,
    5% molasses,
    2.5% Mins/Vits

- **Concentrate feeding practice:**
  - Supplement (x1 or x2 daily feeding) to grass silage
  - *Ad libitum* (to appetite) + grass silage

- **Animal type:** Suckler-bred male cattle
  - ‘Weanlings’ / ‘Growing’ / ‘Finishing’ cattle

- **Management:** Housed indoors, slatted-floor pens

- **Feeding duration:** 70-135 days

- **Animal measurements:** incl.
  - Intake, growth, feed efficiency, + carcass traits
CITRUS PULP
2 experiments

**Exp. 1: ‘Weanling’ cattle:**
- 2 x Concentrates:
  - BAR
  - CIT-100 %
- Grass silage + **1.6 kg concentrate DM / head daily**

**Exp. 2: ‘Finishing’ Cattle:**
- 3 x Concentrates:
  - BAR
  - CIT-40 %
  - CIT-80 %
- Grass silage + **4.0 kg concentrate DM / head daily**

*Source: Lenehan et al. 2017, Teagasc Grange*

*Source: Kelly et al. 2017, Teagasc Grange*
**Results: Exp. 1 – ‘Weanling’ cattle**

<table>
<thead>
<tr>
<th></th>
<th>BAR</th>
<th>CIT100</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final weight (kg)</td>
<td>453</td>
<td>450</td>
<td>NS</td>
</tr>
<tr>
<td>ADG (kg)</td>
<td>0.685</td>
<td>0.656</td>
<td>NS</td>
</tr>
<tr>
<td>Silage DMI (kg/day)</td>
<td>4.40</td>
<td>4.49</td>
<td>NS</td>
</tr>
<tr>
<td>FCR (kg DM/kg ADG)</td>
<td>6.64</td>
<td>6.99</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Conclusion:** Under the conditions of this study, *citrus pulp* had an equivalent feeding value to *rolled barley*.

**Source:** Lenehan et al. 2017, Teagasc Grange
## Results: Exp. 2 – ‘Finishing’ cattle

<table>
<thead>
<tr>
<th>Citrus pulp inclusion - %</th>
<th>0</th>
<th>40</th>
<th>80</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG (kg)</td>
<td></td>
<td>1.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.88&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Silage DMI (kg/day)</td>
<td></td>
<td>5.3</td>
<td>4.9</td>
<td>4.9</td>
</tr>
<tr>
<td>Total DMI (kg/day)</td>
<td></td>
<td>9.3</td>
<td>8.9</td>
<td>8.9</td>
</tr>
<tr>
<td>FCR (kg DM/kg ADG)</td>
<td></td>
<td>9.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Conclusion:** Citrus pulp had a comparable feeding value to rolled barley at inclusion levels up to ca. 40% when offered as a supplement to grass silage.

**Source:** Kelly et al. 2017, Teagasc Grange
SOYA HULLS
3 experiments

Exp. 1: ‘Weanling’ cattle:
- 2 x Concentrates:
  - BAR
  - SH-100 %
- Grass silage + 1.7 kg concentrate DM / head daily

‘Growing-Finishing’ Cattle:
- 5 x Concentrates:
  - BAR
  - SH-20 %
  - SH-40 %
  - SH-60 %
  - SH-80 %
- Exp. 2: ‘Growing’
  - Grass silage + 3.0 kg concentrate DM / head daily
- Exp. 3: ‘Finishing’
  - Concentrate ad libitum + restricted grass silage

Source: Lenehan et al. 2017, Teagasc Grange
## Results: Exp. 1 – ‘Weanling’ cattle

<table>
<thead>
<tr>
<th></th>
<th>BAR</th>
<th>SH100</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final weight (kg)</td>
<td>488</td>
<td>489</td>
<td>NS</td>
</tr>
<tr>
<td>ADG (kg)</td>
<td>0.862</td>
<td>0.875</td>
<td>NS</td>
</tr>
<tr>
<td>Silage DMI (kg/day)</td>
<td>5.28</td>
<td>5.30</td>
<td>NS</td>
</tr>
<tr>
<td>FCR (kg DM/kg ADG)</td>
<td>6.17</td>
<td>6.17</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Conclusion:** Under the conditions of this study, soya hulls had an equivalent feeding value to rolled barley.

**Source:** Lenehan et al. 2015a - Teagasc Grange
Results: Exps. 2 + 3 - ‘Growing-Finishing’ cattle

Conclusions:
Soya hulls had a comparable feeding value to rolled barley-soyabean meal at inclusion levels up to ca. 20% when offered both as a supplement to grass silage & as a high-concentrate diet.

Source: Magee et al. 2015c - Teagasc Grange
PALM KERNEL expeller meal
2 experiments

‘Growing-Finishing’ cattle:
- 5 x Concentrates:
  - BAR
  - PK-10 %
  - PK-20 %
  - PK-30 %
  - PK-40 %

- Exp. 1: ‘Growing’
  - Grass silage + 3.0 kg concentrate DM / head daily

- Exp. 2: ‘Finishing’
  - Concentrate *ad libitum* + restricted grass silage

Source: Magee et al. 2016 - Teagasc Grange
Results: ‘Growing-Finishing’ cattle

<table>
<thead>
<tr>
<th>Palm kernel meal inclusion (%)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Exp. 1 – ‘GROWING’</td>
<td></td>
</tr>
<tr>
<td>ADG (kg)</td>
<td>0.78</td>
</tr>
<tr>
<td>Total DMI (kg/day)</td>
<td>7.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>FCR (kg DM / kg ADG)</td>
<td>9.7&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Exp. 2 – ‘FINISHING’</td>
<td></td>
</tr>
<tr>
<td>ADG (kg)</td>
<td>1.44</td>
</tr>
<tr>
<td>Total DMI (kg/day)</td>
<td>11.1</td>
</tr>
<tr>
<td>FCR (kg DM / kg ADG)</td>
<td>7.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Conclusion: Palm kernel expeller meal had a comparable feeding value to rolled barley/soyabean meal at inclusion levels up to: ca. 40% when offered as a supplement to grass silage, & ca. 10% when offered ad libitum.

Source: Magee et al. 2016 - Teagasc Grange
CORN GLUTEN FEED

1 experiment

‘Finishing’ Cattle:

- 4 x Concentrates
  - BAR
  - CG-25%
  - CG-50%
  - CG-75%

- Grass silage + 4.0 kg concentrate DM / head daily

Source: Kelly et al. 2018, UNPUBLISHED - Teagasc, Grange
### Results: ‘Finishing’ cattle

<table>
<thead>
<tr>
<th>Corn gluten feed inclusion (%)</th>
<th>0</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG (kg)</td>
<td>1.04</td>
<td>1.02</td>
<td>1.06</td>
<td>0.99</td>
<td>NS</td>
</tr>
<tr>
<td>Silage DMI (kg/day)</td>
<td>5.3</td>
<td>5.2</td>
<td>5.3</td>
<td>4.9</td>
<td>NS</td>
</tr>
<tr>
<td>Total DMI (kg/day)</td>
<td>9.3</td>
<td>9.2</td>
<td>9.3</td>
<td>8.9</td>
<td>NS</td>
</tr>
<tr>
<td>FCR (kg DM/kg ADG)</td>
<td>9.0</td>
<td>9.1</td>
<td>9.0</td>
<td>9.2</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Conclusion:** Corn gluten feed had a comparable feeding value to rolled barley/soyabean meal when included at up to 75% in a concentrate supplement to grass silage.

**Source:** Kelly et al. 2018, UNPUBLISHED - Teagasc, Grange
DISTILLERS GRAINS
2 experiments

‘Growing-Finishing’ cattle:

- **Concentrates:**
  - BAR
  - **MAIZE** dried distillers grains (Maize DDG)
    - 20, 40, 60, 80 %
  - **WHEAT** dried distillers grains (Wheat DDG)
    - 20, 40, 60, 80 %

- **Exp. 1: ‘Growing’**
  - Grass silage + **3.0 kg** concentrate DM / head daily

- **Exp. 2: ‘Finishing’**
  - Concentrate *ad libitum* + restricted grass silage

Source: Magee et al. 2015a,b - Teagasc Grange
Results: **Maize DDG – ‘Growing-Finishing’ Exps**

**Exp. 1**

'GROWING' phase - **Supplement: ADG & FCR**

- L: P<0.05
- Q: P<0.05

**Exp. 2**

'FINISHING' phase - *ad libitum*: ADG & FCR

- L: P < 0.05
- NS: P > 0.05

**Source:** Magee et al. 2015b - Teagasc Grange
Results: **Wheat DDG** – ‘Growing-Finishing’ Exps

**Exp. 1**

![Graph showing ADG and FCR in the 'GROWING' phase with L: P<0.05.]

**Exp. 2**

![Graph showing ADG and FCR in the 'FINISHING' phase with L: P<0.05.]
Conclusion - Distillers Grains

Under the conditions of this study:

- Feeding value of Maize DDG > Wheat DDG (ca. 111%) when offered as a supplement to grass silage and as a high concentrate diet.

- Feeding value of Maize & Wheat DDG concentrates were superior to barley-soybean meal when offered as a supplement BUT not when offered as a high-concentrate diet.

- Optimum inclusion level in the concentrate?:
  - up to 80% for Maize & Wheat DDG – supplement to grass silage
  - up to ca. 20% for Wheat & 40% for Maize DDG – offered ad libitum

Source: Magee et al. 2015a,b - Teagasc Grange
By-product feeds: OVERALL conclusion

- Compared to a rolled barley/soyabean meal-based ration:
  - Feeding value of **by-products** is a function of:
    - **Inclusion level** in the concentrate
    - **Feeding level** of the concentrate
      - offered as a **supplement** to grass silage
      - to **appetite** with restricted grass silage.

- Implies that **associative effects** between grass silage & concentrate feed ingredients consequences for feed utilisation & the nutritive value assigned to by-products
Introduction

• Processed maize assigned a superior feeding value to barley in feed tables

• Anecdotal evidence to suggest that maize inclusion in cattle rations enhances fat deposition

However

• Effects of replacing barley with processed maize on growth and carcass fatness are inconsistent in the scientific literature

Objective

• Examine the effects of partially replacing rolled barley with maize meal or flaked-toasted maize on intake, growth and carcass traits of suckler-bred bulls offered a high-concentrate diet

Source: Lenehan et al. 2015b, Teagasc Grange
Experiment details

**Animals:** Charolais & Limousin sired, autumn-born suckler-bred bulls

**Management:** Housed in slatted-floor pens

**Diet:** Offered concentrates *ad libitum* & grass silage *ad libitum*.

**Duration:** 86 days indoor ‘finishing’

**Concentrates:** Coarse rations

- Barley-based control (BAR)
- Maize meal (50% of barley replaced) (MM-50)
- Flaked-toasted maize (50% of barley replaced) (FM-50)

*Source:* Lenehan et al. 2015b, Teagasc Grange
## Results

<table>
<thead>
<tr>
<th></th>
<th>BAR</th>
<th>MM-50</th>
<th>FM-50</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG (kg)</td>
<td>1.81</td>
<td>2.04</td>
<td>1.87</td>
<td>0.08</td>
</tr>
<tr>
<td>Total DMI (kg/day)</td>
<td>11.8</td>
<td>10.9</td>
<td>11.7</td>
<td>0.09</td>
</tr>
<tr>
<td>FCR (kg DMI/kg ADG)</td>
<td>6.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.1&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>*</td>
</tr>
<tr>
<td>Slaughter wt. (kg)</td>
<td>708</td>
<td>732</td>
<td>713</td>
<td>0.06</td>
</tr>
<tr>
<td>Carcass wt. (kg)</td>
<td>406&lt;sup&gt;a&lt;/sup&gt;</td>
<td>420&lt;sup&gt;b&lt;/sup&gt;</td>
<td>409&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>*</td>
</tr>
<tr>
<td>Kill-out proportion (g/kg)</td>
<td>574</td>
<td>574</td>
<td>574</td>
<td>ns</td>
</tr>
<tr>
<td>Carcass conformation (1-15)</td>
<td>9.9</td>
<td>10.4</td>
<td>9.8</td>
<td>ns</td>
</tr>
<tr>
<td>Carcass fat score (1-15)</td>
<td>8.3</td>
<td>7.7</td>
<td>7.4</td>
<td>0.06</td>
</tr>
<tr>
<td>Ribs joint fat proportion (g/kg)</td>
<td>136</td>
<td>124</td>
<td>130</td>
<td>ns</td>
</tr>
</tbody>
</table>

Source: Lenehan et al. 2015b, Teagasc Grange
Conclusions

- Bulls offered MM50 (but not FM50) had superior carcass weight and feed efficiency compared to BAR.

- Maize inclusion in the concentrate did not enhance carcass fat deposition.
Thank You
for your attention

Acknowledgement:
Research Stimulus Funding
• “FEFAN” - 11/S/122
• “BULLBEEF” - 11/SF/322
<table>
<thead>
<tr>
<th>Energy feeds</th>
<th>UFL</th>
<th>UFV</th>
<th>Crude protein %</th>
<th>PDIN g</th>
<th>PDIE g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>1.00</td>
<td>1.00</td>
<td>10.4</td>
<td>64</td>
<td>89</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.00</td>
<td>1.00</td>
<td>10.3</td>
<td>67</td>
<td>92</td>
</tr>
<tr>
<td>Maize</td>
<td>1.05</td>
<td>1.04</td>
<td>8.4</td>
<td>71</td>
<td>103</td>
</tr>
<tr>
<td>Oats</td>
<td>0.89</td>
<td>0.85</td>
<td>9.6</td>
<td>65</td>
<td>73</td>
</tr>
<tr>
<td>Citrus pulp</td>
<td>1.01</td>
<td>0.92</td>
<td>6</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Beet pulp, unmolassed</td>
<td>1.01</td>
<td>0.93</td>
<td>9.1</td>
<td>56</td>
<td>97</td>
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<tr>
<td>Soya hulls</td>
<td>0.91</td>
<td>0.87</td>
<td>11.0</td>
<td>68</td>
<td>94</td>
</tr>
<tr>
<td>Molasses, cane</td>
<td>0.76</td>
<td>0.76</td>
<td>4.5</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td>Protein feeds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>1.02</td>
<td>1.02</td>
<td>48</td>
<td>342</td>
<td>232</td>
</tr>
<tr>
<td>Maize distillers grains</td>
<td>1.03</td>
<td>1.00</td>
<td>25.7</td>
<td>178</td>
<td>119</td>
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<tr>
<td>Maize gluten feed</td>
<td>0.92</td>
<td>0.86</td>
<td>19.8</td>
<td>137</td>
<td>108</td>
</tr>
<tr>
<td>Rapeseed meal</td>
<td>0.91</td>
<td>0.85</td>
<td>33.9</td>
<td>219</td>
<td>130</td>
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<tr>
<td>Urea</td>
<td>0</td>
<td>0</td>
<td>273</td>
<td>1398</td>
<td>0</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>0.59</td>
<td>0.50</td>
<td>25</td>
<td>159</td>
<td>89</td>
</tr>
<tr>
<td>Palm kernal meal, exp.</td>
<td>0.86</td>
<td>0.84</td>
<td>15</td>
<td>117</td>
<td>127</td>
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<tr>
<td>Wheatfeed (pollard)</td>
<td>0.70</td>
<td>0.64</td>
<td>15.3</td>
<td>101</td>
<td>79</td>
</tr>
</tbody>
</table>