



**Harper Adams
University**



**Robert Wilkinson & Simon Marsh, Principal Lecturers, Harper Adams
University, Newport, Shropshire, TF10 8NB**

Animal Science Research Centre - Beef Unit Trial Results – 2019 (c)

**Evaluation of the replacement of concentrates with a high energy forage for
finishing continental dairy-bred steers**

**This research was funded by the Agriculture and Horticulture Development
Board (AHDB)**

Introduction and Objective:

Feed is the main variable cost of finishing beef cattle and typically represents 75% of these costs. With the recent volatility in cereal prices and relatively high price of cereals compared to forages it was thought necessary to evaluate the effect of replacing cereals with a high energy forage with finishing beef cattle. The objective of this experiment was to evaluate replacing cereals with fermented whole crop wheat (WCW) with 400kg continental dairy-bred steers reared through to slaughter at 16-17 months old. Maize silage is considered a very appropriate forage for finishing beef cattle, however it cannot be successfully grown in many parts of the UK compared to wheat, hence why whole crop was the chosen forage.

Animals & Timing:

The trial commenced in the autumn of 2018 with 64 10-12 month old British Blue x Holstein steers weighing approximately 400kg that had been grazed during the summer. The trial commenced on the 14th of November once the animals had become accustomed to housing and their winter diets. The cattle were treated with anthelmintics, vaccinated for protection against pneumonia and clostridial diseases and their backs 'clipped out'. The calves were allocated into four balanced treatment groups in a randomized block design according to live weight.

Treatments:

1. Cereals

Ad libitum 12% Crude Protein (14% CP/kg DM) concentrates based on rolled barley, sugar beet pulp, distillers dark grains, rapeseed meal, molasses and minerals containing 41% starch in the DM, plus *ad libitum* straw.

2. WCW25

Ad libitum 14% CP/kg DM total mixed ration (TMR) based on 25% good quality whole crop wheat with 75% from concentrates on a DM basis.

3. WCW50

Ad libitum 14% CP/kg DM TMR based on 50% whole crop wheat with 50% from concentrates on a DM basis.

4. WCW75

Ad libitum 14% CP/kg DM TMR based on 75% whole crop wheat with 25% from concentrates on a DM basis.

The WCW analysed @ 46.0%DM, 4.4pH, 11.2%CP, 26.5% starch & 10.5ME

The diets were formulated to be iso-nitrogenous i.e. to supply similar quantities of protein. Prior to commencement of the trial all the cattle were fed the WCW50 diet. The rations were fed via troughs and gradually introduced over a 10-14 day period. The cattle were group housed in straw-bedded yards (8.6m x 4.6m per pen) with 3 pens per treatment with 5-6 calves per pen. Straw was offered *ad lib* in racks. Full details of the concentrate rations are shown in appendix 1.

The whole crop wheat (*var*: Shabras Beret Gold) was harvested on the 17th of July 2018, with the aim of harvesting at a dry matter (DM) content of 40-45% at growth stage 83. The WCW was treated with the additive Biotal Gold. The WCW was harvested at a cutting height of 16cm, and chopped using a self-propelled forage harvester. Following cutting, it was ensiled in an Ag-bag. The area harvested was 4.61 ha with a total yield of 137.7 tonnes. This equated to a yield of 12.84 tonnes/DM/ha. The whole crop was costed @ £102/t DM (Maize Growers Association feed costs).



Picture left harvesting WCW on 17th July 2018. Picture right ensiling in an Ag-bag.



Pictures left and right: cattle on the WCW trial at Harper Adams

Results:

Table 1: Animal performance (kg)

(kg/steer)	Cereals	WCW25	WCW50	WCW75	P Value	Sig
Start weight	405.5	405.8	405.0	405.7	0.940	NS
Slaughter weight	641.0	639.8	632.5	640.4	0.865	NS
Days to slaughter	152	153	157	166	0.320	NS
DLWG	1.59	1.53	1.45	1.42	0.553	NS
Age at slaughter (days) ¹	499	500	505	517	0.827	NS

¹ The cattle were 16.4-17 months old at slaughter
 NS = not significant, * = P<0.05, ** = P<0.01, *** = P<0.001

The cattle were slaughtered at ABP Shrewsbury and carcasses classified by Video Image Analysis (VIA).

Table 2: Carcase characteristics

	Cereals	WCW25	WCW50	WCW75	P Value	Sig
Carcase weight (kg)	349.9	346.8	340.0	343.0	0.345	NS
Kill out (%)	54.6	54.2	53.8	53.6	0.166	NS
Carcase DG (kg)	1.07	1.02	0.96	0.93	0.242	NS
CDG from birth (kg)	0.70	0.68	0.66	0.61	0.142	NS
Conformation ¹ (1-15)	7.9 (R=)	8.30	7.80	7.40	0.210	NS
Fat class ¹ (1-15)	7.69	7.40	8.1 (3=)	7.60	0.437	NS
Liver score ² (1-5)	1.3 ^a	1.0 ^a	1.0 ^a	2.0	0.021	*

Within row, means with the same superscript are not significantly different ($p>0.05$).

¹ EUROP carcase classification: Conformation: P=-1 and E+=15, Fat class: 1- =1 and 5+=15.

² Liver assessment: 1= Healthy liver and 5 = Severe abscesses (due to acidosis).

All of the carcasses would be regarded as ideal for the processors and supermarkets. The low liver scores across the four treatments indicated minimal issues with acidosis. The highest liver score with the WCW75 treatment is difficult to explain and is assumed to be an anomaly.

Table 3: Feed intakes (kg/head) and feed conversion ratio (FCR)

	Cereals	WCW25	WCW50	WCW75	P Value	Sig
Total DM intake	1,416	1,879 ^a	1,960 ^a	2,036 ^a	0.002	**
Daily DM intake	9.4	12.25 ^a	12.50 ^a	12.21 ^a	<0.001	***
Total WCW DM intake	0.0	470 ^a	980 ^a	1,527 ^a	<0.001	***
Daily Conc DM intake	9.4	9.2	6.3	3.1	<0.001	***
Livewt FCR	6.0	8.03 ^a	8.62 ^a	8.64 ^a	0.003	**
Daily carcase gain FCR	8.87	12.00 ^a	13.06 ^a	13.29 ^a	0.001	**

There was a significant increase in dry matter intakes with the inclusion of WCW in the ration. Since WCW has a lower energy value than cereals this would help partially overcome a reduction in ME intakes with the WCW treatments.

Table 4: Financial performance (£)

	Cereals	WCW25	WCW50	WCW75	P Value	Sig
Carcase price (£/kg)¹	3.39	3.42	3.39	3.35	0.164	NS
Carcase value (£)	1,187	1,185	1,152	1,149	0.344	NS
Total feed cost per head (£)²	306 ^a	352	320 ^a	284	0.007	*
Daily feed cost (£/head)	2.03 ^a	2.30	2.04 ^a	1.70	<0.001	***
Feed cost/kg live wt gain (£/kg)	1.30 ^a	1.51	1.41 ^a	1.20	0.043	*
Feed cost/kg carcass gain (£/kg)	1.91 ^{ab}	2.25	2.13 ^b	1.85 ^a	0.022	*
Margin over Feed (£/steer)³	234	181	188	226	0.153	NS
Margin (£/kg carcass gain)³	1.47 ^b	1.17 ^a	1.26 ^{ab}	1.50 ^b	0.085	Trend

¹ Carcass price standardised to the ABP price grid with a base price of £3.38/kg.

² Feed costs as follows: Whole crop @ £102/t DM), Cereal mix @ £187/t, WCW25 Concs @ £188/t, WCW50 Concs @ £195/t, WCW75 concs @ £221/t.

³ Margin over Feed calculated from: Value of Carcass Gain MINUS Feed costs.

The carcass value was highest for the Cereal and WCW25 treatments. The lowest feed costs were recorded by the WCW75 treatment. The highest Margin over Feed Costs were recorded with the Cereals and WCW75 diets.

Discussion & Conclusions:

- Overall performance of the British Blue x Holstein steers was very good with cattle being slaughtered at 16-17 months old with carcass weights of 340-350kg exceeding the recognised target for 18-month beef production systems.
- Carcass weights were similar across the 4 treatments, however cattle on the forage based diets tended to take longer to reach slaughter weight hence DLWG and CDG showed a decline with increasing amounts of forage in the ration, but this however was not statistically significant.
- Replacing cereals with WCW increased daily DMI, which partially compensated for the reduced energy density (M/D) of the diets, but resulted in a poorer FCR.
- Diet costs were lowest with the WCW75 treatment. They were similar for the cereals and WCW50 and highest for the WCW25 treatment.
- Margins were similar for the Cereals and WCW75. However lower for the WCW25 and WCW50.
- Carcass classification was similar across all treatments and ideal for the meat trade.
- The earlier slaughter of the steers fed *ad-lib* cereals would result in a small reduction in variable and fixed costs. However the fixed costs for a forage based system would require silage clamps, a feeder wagon and materials handler which would be significantly higher than one based on feeding cereals from hoppers.
- If farm resources are available to make, store and handle forage the replacement of **75%** of cereals with **well-made good quality high energy (25+% starch, 10.5+ME) whole crop** should be considered.
- The overall conclusion is that farmers should either finish cattle on either *ad-lib* cereal systems or consider replacing a significant proportion of cereals i.e. 75% with a high energy forage.

Acknowledgement:

The authors would like to extend their sincere thanks to AHDB Beef & Lamb for supporting this work and the staff at ABP Shrewsbury for their assistance with the liver scoring. We would also like to thank Rumenco Ltd for analysing the forages. This study was used by BSc IV Agric students Jonathan Williams and Fraser Hyslop as the basis for their Honours Research Projects who assisted with feeding the cattle and recording the data.

Appendix 1

Concentrate feed formulation, analysis and costs

Feeds (kg/t)	Ad Lib Concs	25 WCW	50WCW	75WCW
Rolled barley	716	700	586	217
Sugar beet pulp	103	100	83	31
Rapeseed meal	54	81	147	347
Wheat distillers	53	80	143	340
Molasses (cane)	57	15	23	47
Mins/vits	17	24	18	18
PRICE (£/t)¹	187	188	195	221
Composition (g/kg DM)				
DM (g/kg)	865	869	872	879
CP	140	154	183	271
ERDP (0.5)	103	113	135	199
DUP (0.5)	20	22	25	33
Oil	23	25	28	36
Ash	59	64	62	73
NDF	239	254	273	325
Starch	414	405	346	156

¹: Feed costs used: Barley @ £158/t, Beet pulp @ £210/t, Rapeseed meal @ £211/t, Distillers @ £235/t, Molasses @ £200/t & Mins @ £290/t plus £10/t mill and mix charge. Feed costs provided by David Hendy, 'Rumen Development: Rumen Management', Blackbrook Farm, Great Harkesley, Colchester. Essex. (Tel 07887 730747)

August 2019