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Animal Science Research Centre - Beef Unit Trial Results – 2017 (b)

**Evaluation of the total replacement of barley with wheat with diets containing
nutritionally improved straw on the performance of intensively finished bulls**

Introduction and Objective:

It is acknowledged that starch is the key nutrient driver to optimise daily live weight gain (DLWG) with intensive finishing systems for beef cattle (Marsh & Brown, 2007). Barley is the predominant cereal used in intensive diets and typically contains 590g starch/kg DM. Wheat contains 690g starch/kg DM, however it is seldom fed to intensively finished beef cattle, or its inclusion rate is limited with the recommendation to only replace just 50% of barley with wheat. Wheat contains high levels of gluten and excessive amounts, particularly if the grains are finely ground, can result in a sticky dough mass in the rumen, discomfort for the animal and digestive disturbances such as acidosis (Lonsdale, 1999). Liver abscesses (which can be identified at the abattoir) are associated with mild acidosis from feeding diets with a high starch content (Owens *et al.*, 1998). It could therefore be assumed that reduced rumen acidosis should result in improved performance.

The objective of this experiment at Harper Adams University was to determine the effect of the total replacement of barley with wheat in blends formulated to contain 435-460g starch/kg DM (37-39.5% 'as fed'), formulated to include 10% nutritionally improved straw (NIS), to intensively finished dairy-bred bulls.

NIS is chopped and pelleted straw treated with sodium hydroxide. The fibrous and alkaline properties of NIS may therefore enable wheat to be included in intensive beef diets with potential improvements in animal performance and profit.

Animals & Timing:

34 Sept-Oct 2015 born British Blue x Holstein bulls weighing approximately 325kg at 7 months old were randomized according to live weight to the following treatments:

Treatments:

Barley/Wheat/NIS

Ad libitum 14% Crude Protein (16% CP/kg DM) cereal blend based on rolled barley, wheat, NIS, soyabean meal, distillers dark grains, molasses and minerals containing approximately 43% starch in the DM (37% as fed).

Wheat/NIS

Ad libitum 14% Crude Protein (16% CP/kg DM) cereal blend based on rolled wheat, NIS, soyabean meal, distillers dark grains, molasses and minerals containing approximately 46% starch in the DM (39% as fed).

Details of the formulation and analysis of the above rations are shown in appendix 1. Straw was offered *ad lib* to both groups of bulls from racks.

Results:

Table 1: Animal performance (kg)

(Kg/bull)	Barley/Wheat/NIS	Wheat/NIS	s.e.d	P Value	Sig
Start wt	328	329	2.2	0.534	NS
Slaughter wt	584	577	7.8	0.415	NS
Days to slaughter	192	195	6.4	0.739	NS
DLWG	1.35	1.29	0.052	0.243	NS
Age at slaughter (days)	405 (13.3 months)	412 (13.5 mo)	6.5	0.665	NS

NS = not significant, * = P<0.05, ** = P<0.01, *** = P<0.001

The bulls were slaughtered at ABP Shrewsbury with the carcasses graded by Video Image Analysis (VIA).

Table 2: Carcase characteristics

	Barley/Wheat/NIS	Wheat/NIS	s.e.d	P Value	Sig
Carcase wt (kg)	329.9	323.5	5.4	0.258	NS
Kill out (%)	56.5	56.0	0.49	0.338	NS
Carcase DG from birth (kg)	0.82	0.79	0.039	0.193	NS
Conformation ¹ (1-15)	7.6 (R-/R=)	7.3 (R-)	0.312	0.333	NS
Fat class ¹ (1-15)	5.4 (2=/2+)	4.9 (2=)	0.302	0.183	NS
Liver score ² (1-5)	1.63	1.00	0.249	0.096	Trend

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).

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

	Barley/Wheat/NIS	Wheat/NIS
Total concentrate intake (kg)	1,618	1,514
Daily concentrate intake (kg)	8.43	7.76
FCR (kg feed: kg lwt gain)	6.32	6.10
FCR (kg feed: kg carcase gain)	10.28	9.83

The FCRs (kg feed: kg liveweight gain) appear relatively high compared to the target of 5.0:1 for cereal fed Continental x Holstein bulls but it must be taken into consideration that the experiment did not include the period of growth from 120kg to 330kg for this batch of bulls. During this rearing phase the bulls recorded a DLWG of 1.75kg having consumed 719kg of concentrates equating to an FCR of 3.42:1. Overall feed intakes from 12 weeks old to slaughter were therefore 2,327kg (fresh weight) per head for the bulls.

Table 4: Financial performance (£)

	B/W/NIS	W/NIS	s.e.d	P Value	Sig
Carcase price ¹ (£/kg)	3.38	3.33	0.038	0.190	NS
Carcase value (£)	1,114	1,076	25.3	0.134	NS

Feed cost (£/t)	194	195	
Feed cost (£/bull)	314	295	
Margin over Feed (£/bull)	800	781	
Feed cost/kg live wt gain (£/kg)	1.21	1.17	
Feed cost/kg carcass gain (£/kg)	1.99	1.92	

[†] Carcass price standardised to a base price of £3.45/kg.

Overall the Blue x Holstein bulls returned a gross margin of £287 per head when calculated from being reared as calves through to slaughter.

Discussion & Conclusions:

- Overall performance of the bulls was good with them being slaughtered at 13.4 months old with carcass weights of 327kg meeting the recognised targets for intensive cereal beef production of 14 months and 330kg respectively.
- There was a numerical improvement in DLWG (+0.06kg), slaughter weight (+7kg) carcass weight (+6.4kg) and daily carcass gain (+0.03kg) with bulls fed the Barley/Wheat/NIS ration however the differences were not statistically significant.
- The bulls fed Wheat/NIS recorded lower fat classifications. Whilst this was not statistically significant, R grade carcasses at ABP grading 2= receive a deduction of 10p/kg compared to carcasses grading 2+ which is the main reason for the difference in carcass price (£/kg) of the Wheat/NIS bulls.
- The Wheat/NIS bulls recorded a lower (P<0.096) liver score. All of the livers from the Wheat/NIS bulls were perfect.
- The bulls fed the Wheat/NIS diet recorded lower feed intakes resulting in improved FCR's.
- Based on the costs prevailing at the time of the study the bulls fed the Barley/Wheat/NIS based ration recorded an increase in carcass value of £38 with a higher margin over feed of £19 per bull. However the Wheat/NIS bulls recorded a lower feed cost per kg LWG of 4p/kg (7p/kg for carcass gain)
- The Wheat/NIS ration was £1 per tonne higher in price in the study. A sensitivity analysis would show a financial benefit if wheat prices fall in relation to barley.
- The replacement of barley with wheat with diets containing NIS has enabled bulls to be fed diets solely on wheat as the cereal source.

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References:

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- Marsh, S.P. and Brown, S.T. 2007 Effect of feeding a compound feed with a reduced starch content on the performance of intensively fed beef cattle *Proceedings of the British Society of Animal Science*. Paper 127
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Appendix:

Trial diets

Feeds (kg/t)		Barley/Wheat/NIS	Wheat/NIS
Rolled Barley		330	
Rolled Wheat		330	660
NIS		100	100
Hipro Soya		82.5	82.5
Distillers Grains		82.5	82.5
Molasses		50	50
Minerals		25	25
		1000	1000
Analysis			
ME	MJ/kg	10.8	10.9
ME	MJ/kg DM	12.5	12.7
Protein	g/kg as fed	141	143
Protein	g/kg DM	164	166
Starch	g/kg as fed	374	394
Starch	g/kg DM	433	456
Sugar	g/kg as fed	53	56
Sugar	g/kg DM	61	64
NDF	g/kg as fed	172	159
NDF	g/kg DM	199	184
Crude Fibre	g/kg as fed	60	53
Crude Fibre	g/kg DM	69	61

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