

###### ANIMAL SCIENCE RESEARCH CENTRE

**Evaluation of early weaning concentrate quality on the performance and health of artificially reared beef calves to 12 weeks**

**DRAFT TRIAL REPORT CR39**

**For Bonanza Calf Nutrition**

### **Simon P. Marsh**

**Principal Lecturer – Beef Cattle Specialist**

**Harper Adams University**

**Newport**

**Shropshire**

**TF10 8NB**

**28 May 2014**

**Contents**

|  |  |  |
| --- | --- | --- |
|  |  | Page |
|  | SUMMARY | 3 |
|  |  |  |
| 1 | INTRODUCTION AND OBJECTIVES | 4 |
|  |  |  |
| 2 | MATERIALS AND METHODS | 4 |
|  | 2.1. Location | 4 |
|  | 2.2. Animals and Timing | 4 |
|  | 2.3. Treatments | 4 |
|  | 2.4. Management | 5 |
|  |  |  |
| 3 | RESULTS - Calf performance | 6 |
|  | 3.1. Liveweight | 6 |
|  | 3.2. Daily live weight gain | 6 |
|  | 3.3. Age at start and weaning | 7 |
|  | 3.3. Body measurements | 7 |
|  | 3.4. Feed intakes | 7 |
|  | 3.5. Financial appraisal | 8 |
|  |  |  |
| 4 | RESULTS - Calf health | 8 |
|  |  |  |
| 5 | DISCUSSION & CONCLUSIONS | 9 |
|  |  |  |
| 6 | ACKNOWLEDEMENTS | 9 |
|  |  |  |
| 7 | REFERENCES | 10 |
|  |  |  |
| 8 | APPENDICES | 11 |

**Summary**

Thirty-eight Continental cross Holstein calves were purchased at a mean age of 18.9 days and artificially reared on milk replacer (Shine, Bonanza Calf Nutrition) supplemented with either a standard good quality concentrate containing high levels of starch and soya bean meal or a concentrate formulated with a high fibre content from feedstuffs such as soya hulls with protein supplied primarily from maize gluten, distillers grains and rapeseed meal i.e. an evaluation of ‘good quality’ versus ‘medium quality’ starter pellet. The concentrates were formulated to be iso-nitrogenous (180g CP/kg) and iso-energetic (13.1ME [MJ/kg DM]).

Overall performance of the calves was very good significantly exceeding the target of 122kg for rearing calves to 15 week of age. The 12 week weights for the starch and fibre based concentrates was 139.1 and 136.1kg respectively. This excellent performance is likely to be partially due to the standard of stockmanship and feeding a high quality milk replacer. There was zero calf mortality in the study.

There were no significant differences in calf performance. There was however a numerical improvement in DLWG and liveweight and by 12 weeks the starch fed calves had gained an extra 2.4kg.

There were no significant differences in calf health between the treatments however there was a trend (P=0.09) for an improvement coat bloom with the starch fed calves.

The fibre fed calves recorded higher overall concentrate intakes and due to their slightly poorer performance resulted in a deterioration in the feed conversion ratio (FCR). Feed costs per calf were similar however feed cost per kg gain were lower with the starch based concentrates despite the fibre based concentrate being £8 per tonne cheaper.

It can be concluded calf rearers should offer their calves a good quality starter concentrate based on cereals with the inclusion of some soyabean meal.

**1.0 Introduction and Objectives**

Successful rearing of a ruminant relies on a number of inputs that interact with each other, to get a desirable output. In terms of calf rearing, this involves ensuring an early and adequate intake of colostrum and supplying the calf with adequate nutrition through milk, concentrates and forage, as well as suitable housing and necessary veterinary and medicine treatments to grow the calf as quickly and efficiently as possible (Moran, 2002). Davis and Drackley (1998) also state that successful calf rearing combines good nutrition, health and careful management of the calf. Putting this theory into practice requires a good knowledge of the animal's requirements along with practical experience in the industry.

As the demand for food production is ever increasing, and consequently the cost of animal feed is increasing, efficiencies in the rearing process are moving further up the list of farmers' priorities (EBLEX, 2014).

Some calf rearers have attempted to cut rearing costs by buying cheaper concentrates. The nutritional value of these concentrates is often reduced by using poorer quality sources of essential nutrients such as replacing soya bean meal (48% protein), with distillers grains (27% protein) (Parish, 2009).

The objective of this experiment was to investigate the effect of early weaning concentrate quality on the performance and health of artificially reared dairy-bred beef calves to 12 weeks. A standard good quality concentrate containing high levels of starch (from cereals) with soya bean meal was evaluated against a concentrate with a high fibre content formulated from feedstuffs such as soya hulls with protein supplied primarily from maize gluten, distillers grains and rapeseed meal i.e. an evaluation of ‘good quality’ versus ‘medium quality’ starter pellet.

**2.0 Materials & Method**

**2.1 Location**

Harper Adams University beef unit, Newport, Shropshire, TF10 8NB.

**2.2 Animals & Timing**

The trial commenced on the 30th of September 2013 with 38 mid-September to end October 2013 born Continental cross Holstein bull calves at 8 to 30 days old (mean 18.9 days). This would therefore be representative of beef producers purchasing dairy-bred calves either from markets or direct from dairy farms.

**2.3 Treatments**

The calves were individually penned and allocated in a randomized block design according to live weight and breed into the following feeding treatments with nineteen calves per treatment.

Starch Calves fed warm whey, skim and buttermilk based milk replacer (Shine [20% CP, 17% Oil]) mixed at 37oC at 175g per 825ml of water and fed at 1.7 litres per feed twice per day i.e. 600g/h/d of milk replacer. Calves were offered *ad lib* starch based 18%CP early weaning concentrates (containing soyabean meal) and gradually weaned. When calves were recorded to be eating 1.0kg/d of concentrates for 3 consecutive days the milk replacer feed rate was reduced to 0.85 litres per feed (i.e. half rate) for 3 days when the calf was weaned.

Fibre Calves fed warm whey, skim and buttermilk based milk replacer (Shine [20% CP, 14% Oil]) mixed at 37oC at 175g per 825ml of water and fed at 1.7 litres per feed twice per day i.e. 600g/h/d of milk replacer (CMR). Calves offered *ad lib* 18%CP fibre based early weaning concentrates (low starch and no soyabean meal) and gradually weaned ‘as per’ the starch treatment.

The calves were moved into a group pen at weaning until 12 weeks.

The concentrates were formulated to be iso-nitrogenous (180g CP/kg) and iso-energetic (13.1ME [MJ/kg DM]). Details of the formulation and statutory declaration of the above rations are shown in appendix 1. The concentrate rations were analysed by Near Infrared Reflectance Spectroscopy (NIR) by Rumenco Ltd and the results shown in table 1.The CMR was analysed using traditional wet chemistry techniques.

Table 1: Feed analysis results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Shine CMR** | | **Starch Concs** | | **Fibre Concs** | |
|  | **Declared** | **Analysed** | **Declared** | **Analysed** | **Declared** | **Analysed** |
| **Crude Protein (%)** | 20.0 | 20.1 | 18.0 | 20.4 | 18.0 | 20.7 |
| **Oil B (%)** | 17.0 | 19.1 | 3.9 | 5.1 | 4.5 | 5.2 |
| **Crude Fibre (%)** | 0.07 | 0.1 | 7.8 | 7.4 | 13.3 | 11.0 |
| **Ash (%)** | 7.5 | 6.5 | 7.2 | 6.3 | 7.4 | 7.1 |
| **Starch (%)** | N/A | N/A | 24.0 | 29.9 | 12.5 | 12.8 |
| **ME (MJ/kg DM)** | N/A | N/A | 13.0 | 12.9 | 13.0 | 12.6 |

**2.4 Management**

The calves were bedded on straw (see plate 1) and dehorned at 3 weeks (on trial). Water, straw (from racks) and concentrates were offered from the start.

Calves were given 8g/day of multi vits (Jolivo, The Calf Company) for 5 days (40g in total) on arrival. Calves were vaccinated with 5ml BovilisTM Bovipast RSP (MSD Animal Health) a day after arrival and at 4 weeks on trial. If a calf required electrolytes (ASGold, Volac International Ltd) these were given as a separate feed either at mid-day or in the morning with the morning allocation of milk fed at mid-day.

At weaning the calves were placed into group pens to 12 weeks with straw offered from racks and offered the same early weaning concentrates *ad lib* as fed from start to weaning.



*Plate 1: The Harper Adams University calf unit*

The data were analysed using ANOVA (15th Edition) with ‘start weight’ and ‘age at start’ as co-variates.

**3.0 Results – Calf Performance**

Overall calf performance was very good recording live weights that exceeded the recognised target of 122kg for 15 week old calves (Dawson, 2009).

**3.1 Liveweight**

The starch fed calves gained an extra 2.4kg live weight however as shown in table 2 there were no significant differences between the treatments.

Table 2: Animal performance (kg/calf)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Start** | 55.2 | 54.6 | 1.01 | NS |
| **3 weeks** | 69.0 | 67.9 | 1.56 | NS |
| **Weaning** | 86.7 | 85.5 | 1.80 | NS |
| **12 weeks** | 139.1 | 136.1 | 4.47 | NS |
| **Increase in livewt** | 83.9 | 81.5 |  |  |

Within row, means with the same superscript are not significantly different (*P*>0.05)

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

**3.2 Daily live weight gain (DLWG)**

Daily live weight gain (DLWG) was calculated by the difference from 12 weeks to start weight.

Table 3: DLWG (kg)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Start - 3 weeks** | 0.66 | 0.63 | 0.056 | NS |
| **Start - weaning** | 0.73 | 0.72 | 0.044 | NS |
| **Wean - 12 weeks** | 1.28 | 1.19 | 0.095 | NS |
| **Start -12 weeks** | 1.00 | 0.97 | 0.050 | NS |

The starch fed calves recorded higher DLWGs from weaning to 12 weeks however there were no significant differences.

**3.3 Age at start and weaning**

The age of the calves at the start and weaning are shown in table 4. There was no difference in age at weaning with the calves being weaned off milk at approximately 9 weeks old.

Table 4: Calf age (days)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Age at start (days)** | 19.4 | 18.5 | 2.18 | NS |
| **Age at weaning (days)** | 63.1 | 62.4 | 2.93 | NS |
| **Days on trial** | 43.7 | 43.9 | 2.12 | NS |

**3.4 Body measurements**

The calves wither height, heart girth, hip height, hip width and last rib girth measurement were recorded at the start, 3 weeks, weaning, and 12 weeks. The results for 12 weeks are presented in table 5.

Table 5: Calf measurements (cm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Heart girth (cm)** | 119.5 | 118.2 | 1.18 | NS |
| **Wither height (cm)** | 95.1 | 94.4 | 1.07 | NS |
| **Hip height (cm)** | 100.4 | 99.9 | 1.26 | NS |
| **Hip width (cm)** | 23.8 | 23.2 | 0.51 | NS |
| **Last rib girth (cm)** | 142.2 | 142.3 | 3.38 | NS |

It is interesting to note that the wither height, heart girth, hip height and hip width are fractionally and consistently higher for the starch fed calves indicating possible improvement of frame development.

**3.4 Feed intakes**

It can be seen from table 6 that the fibre fed calves recorded higher overall concentrate intakes and due to their slightly poorer performance resulted in a deterioration in the feed conversion ratio (FCR). This is in agreement with the majority of published work when starch based feedstuffs are replaced with fibre based feedstuffs.

Table 6: Feed intakes (kg/calf) and feed conversion ratio (FCR)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Milk replacer** | 25.3 | 25.4 | 1.72 | NS |
| **Concs - start to wean** | 20.2 | 19.7 | 1.76 | NS |
| **Concs - wean to 12 weeks** | 144.2 | 149.7 |  |  |
| **Concs - total** | 164.4 | 169.4 |  |  |
| **FCR - start to weaning** | 1.44 | 1.46 | 0.68 | NS |
| **FCR - start to 12 weeks** | 2.26 | 2.39 |  |  |

**3.5 Financial appraisal**

A financial appraisal was carried out based on the feed costs prevailing at the time of the study and is shown in table 7.

Table 7: Financial performance (£)

|  |  |  |
| --- | --- | --- |
| **Feed costs (£/calf)** | **Starch** | **Fibre** |
| **CMR @ £1,950/t** | 49.33 | 49.53 |
| **Starch Concs @ £304/t** | 49.98 |  |
| **Fibre Concs @ £296/t** |  | 50.14 |
| **Feed costs/calf (£)** | 99.31 | 99.67 |
| **Feed cost per kg gain (£)** | 1.18 | 1.22 |

Feed costs per calf and per kg gain were calculated. From the results shown in table 7 total feed costs per calf were similar however feed cost per kg gain were lower with the starch based concentrates despite the fibre based concentrate being £8 per tonne cheaper.

**4.0 Results – Calf Health**

Calf health was determined using recognised scoring systems with lower scores indicting normal (better) health status. The following health scores were recorded; hydration score (Ely & Guthrie, 2000); cough score, nasal discharge and eye discharge score (Linderoth, 2007); ear score and faecal scores (McGuirk, 2009). Calf coat bloom was recorded on a 5 point scale with 1 equating to dull, 3 as normal and 5 as shiny. All marking scales allowed for a quarter point mark. Full details are shown in appendices 2-7.

Calves were recorded at weeks 1 to 4 and 12. There were no significant differences in calf health between the treatments and full details of the results are shown in appendix 8. There was however a trend (P=0.09) for the calves on the starch based treatment to record an improved coat bloom score at 4 weeks as shown in table 8.

Table 8: Calf coat bloom score (1-5)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 3.37 | 3.61 | 0.201 | NS |
| **Week 2** | 3.26 | 3.16 | 0.155 | NS |
| **Week 3** | 3.34 | 3.61 | 0.205 | NS |
| **Week 4** | 3.47 | 3.16 | 0.182 | =0.09 |
| **12 weeks** | 3.47 | 3.37 | 0.164 | NS |

**5.0 Discussion and Conclusions**

* Overall performance of the calves was very good significantly exceeding the target of 122kg for rearing calves to 15 week of age. This I would suggest is due to the standard of stockmanship and feeding a high quality milk replacer. There was zero calf mortality in the study.
* There were no significant differences in calf performance with feeding either a standard good quality concentrate containing high levels of starch (from cereals) with soya bean meal compared to a concentrate formulated with a high fibre content from feedstuffs such as soya hulls with protein supplied primarily from maize gluten, distillers grains and rapeseed meal. There was however a numerical improvement in DLWG and liveweights and by 12 weeks the starch fed calves had gained an extra 2.4kg.
* There were no significant differences in calf health between the treatments however there was a trend (P=0.09) for an improvement coat bloom with the starch fed calves.
* The fibre fed calves recorded higher overall concentrate intakes and due to their slightly poorer performance resulted in deterioration in the feed conversion ratio (FCR).
* Total feed costs per calf were similar however feed cost per kg gain were lower with the starch based concentrates despite the fibre based concentrate being £8 per tonne cheaper.

It can be concluded calf rearers should offer their calves a good quality starter concentrate based on cereals with the inclusion of some soyabean meal.

**6.0 Acknowledgements**

The author would like acknowledge the support from Bonanza Calf Nutrition for funding the study. The contribution of Katie James and Jack Hanson who undertook this work as part of their BSc Honours Research Projects is also gratefully acknowledged, as is the support of the ruminant technicians at Harper Adams University.

**7.0 References**

Davis, C.L. and Drackley, J.K. 1998. *The Development, Nutrition and Management of the Young Calf*. Iowa: Iowa State University Press.

Dawson, L., Morrison, S., Weatherup, N., McHenry, P., Burns, R. and Fee, S. 2009. *Blueprint for rearing dairy origin calves*. [On-line]. Department of Agriculture and Rural Development. Available from: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.afbini.gov.uk%2Fblueprint-for-rearing-dairy-origin-calves.pdf&ei=\_7VcU4OTI4KqO5fJgMAB&usg=AFQjCNE--9anJj5F1OFpQEPjeyU3egl32w&bvm=bv.65397613,d.ZWU&cad=rja [Accessed 16 April 2014].

EBLEX (English Beef and Lamb Executive). 2014. *Beef and sheep farmers more optimistic about industry prospects*. [On-line]. AHDB (Agricultural and Horticultural Development Board). Available from: http://www.eblex.org.uk/news-releases/beef-and-sheep-farmers-more-optimistic-about-industry-prospects/ [Accessed 5 April 2014].

Ely, L & Guthrie L. 2000. *Raising Dairy Herd Replacements.* Extension Dairy Science. [Available from: <http://pubs.caes.uga.edu/caespubs/pubs/PDF/B831.pdf>]

Accessed 03 November 2008.

Linderoth, S. 2007. *Check calves from head to tail.* Dairy Herd Management.

[Available from: [http://www.dairyherd.com/directories.asp?pgID=724 &ed\_id=6219](http://www.dairyherd.com/directories.asp?pgID=724%20&ed_id=6219)]

Accessed 03 November 2008.

McGuirk. S. 2009. *Calf Health Scoring Chart.* University of Wisconsin. – School of Veterinary Medicines [Available from: <http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf>]

Accessed 19 September 2012.

Moran, J. 2002. *Calf Rearing- A practical guide.* 2nd ed. Australia: Landlinks Press.

Parish, J. 2009. *Protein Supplies for Beef Cattle Diets*. [On-line]. Cattle Business in Mississippi. Available from: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CC4QFjAA&url=http%3A%2F%2Fmsucares.com%2Flivestock%2Fbeef%2Fmca\_may2009.pdf&ei=in9eU721FaXy7Aab0oHABA&usg=AFQjCNEwe0ezZUHD0rWJaN1iiSTFQ-qFCQ&bvm=bv.65397613,d.ZGU [Accessed 8 April 2014].

Whilst we consider that this work has been carried out in accordance with good industry practice, the University will not be liable for any use which may be made, reliance which may be placed, nor advice or information given, in connection with the results contained herein for commercial purposes.

**Appendix 1**

Trial diet formulation and theoretical analysis

|  |  |  |
| --- | --- | --- |
| **Name** | **(FM) Formula** | **(FM) Formula** |
|  | **B350P, HGM Calf Starter Pellets Winter 2** | **HA6000, Harper Adams calf treatment** |
|  |  |  |
| **Wheat** | 14.20 | 0.00 |
| **Maize** | 17.00 | 7.73 |
| **GM Distillers Grains** | 8.21 | 15.00 |
| **GM Maize Gluten** | 10.30 | 25.00 |
| **Pollard Pellets** | 10.20 | 10.00 |
| **Rapeseed Ext.** | 7.28 | 10.58 |
| **GM Hipro Soya** | 10.50 | 0.00 |
| **GM Soya Hulls** | 10.40 | 23.84 |
| **Molaferm (Press)** | 8.50 | 5.00 |
| **PFAD(Spray) Blend** | 0.75 | 0.75 |
| **Fine Limestone** | 1.50 | 1.00 |
| **Salt** | 0.67 | 0.60 |
| **Calf Supplement** | 0.50 | 0.50 |
|  |  |  |
| [VOLUME] | 100 | 100 |
| **Theoretical analysis**  **- % as fed** |  |  |
| PROTEIN | 18 | 18 |
| OIL (Method A) | 3.4 | 4.0 |
| CRUDE FIBRE | 7.8 | 13.3 |
| CRUDE ASH | 7.2 | 7.4 |
| MER NEW (MJ) | 11.3 | 11.3 |
| Magnesium | 0.22 | 0.26 |
| STARCH | 24.0 | 12.5 |
| STARCH & SUGAR | 31.9 | 18.2 |
| UDP NEW | 5.9 | 5.8 |
| OIL (Method B) | 3.9 | 4.5 |
| IN\_OIL | 3.2 | 3.5 |
| FME | 9.8 | 9.5 |
| NDF | 21.8 | 34.2 |

Shine CMR - declared analysis

|  |  |
| --- | --- |
|  | Declared |
| Moisture (%) | 4 |
| Crude Protein (CP) | 20 |
| Oil (%) | 17 |
| Ash (%) | 7.5 |
| Fibre (%) | 0.07 |
| Vit A (IU/kg) | 30,000 |
| Vit D3 (IU/kg) | 6,000 |
| Vit E (IU/kg) | 100 |
| Vit B1 (mg/kg) | 1 |
| Vit K3 (mg/kg) | 1 |
| Vit C (mg/kg) | 75 |
| Copper (mg/kg) | 5 |
| Iron (mg/kg) | 20 |
| Selenium (mg/kg) | 0.22 |
| Zinc (mg/kg) | 24 |
| Manganese (mg/kg) | 25 |
| Cobalt (mg/kg) | 2.5 |

**Appendix 2 – Calf Dehydration Score**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Score** | **1** | **2** | **3** | **4** | **5** |
| **Skin pinch test** | **Returns to normal quickly** | **Returns to normal slowly (several seconds)** | **Skin folds** | **Weak body** | **Dead** |

**Source:** Based on Table below.



**Source:** Ely, L & Guthrie L. 2000. *Raising Dairy Herd Replacements.* Extension Dairy Science. [Available from: <http://pubs.caes.uga.edu/caespubs/pubs/PDF/B831.pdf>]

Accessed 03 November 2008.

**Appendix 3 – Calf Cough Score**

Enter the pen or hutch, and squeeze the calf’s trachea with some pressure while giving it a little shake. Listen for any coughs. Use the health-scoring chart to assign cough scores to each calf. For example, a calf that scores “0” does not cough, while one that scores “3” will have repeated spontaneous coughs after this procedure.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Score** | **0** | **1** | **2** | **3** |
|  | **None** | **Induce single cough** | **Induced repeated coughs or occasional spontaneous cough** | **Repeated spontaneous coughs** |

Source: Linderoth, S. 2007. *Check calves from head to tail.* Dairy Herd Management.

[Available from: [http://www.dairyherd.com/directories.asp?pgID=724 &ed\_id=6219](http://www.dairyherd.com/directories.asp?pgID=724%20&ed_id=6219)]

Accessed 03 November 2008.

**Appendix 4 – Nasal discharge score**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Score** | **0** | **1** | **2** | **3** |
|  | **Normal serous discharge** | **Small amount of unilateral cloudy discharge** | **Bilateral, cloudy or excessive mucus discharge** | **Copious bilateral mucopurulent discharge** |
|  |  |  |  |  |

Source: Linderoth, S. 2007. *Check calves from head to tail.* Dairy Herd Management.

[Available from: [http://www.dairyherd.com/directories.asp?pgID=724 &ed\_id=6219](http://www.dairyherd.com/directories.asp?pgID=724%20&ed_id=6219)]

Accessed 03 November 2008.

**Appendix 5 – Eye discharge score**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Score** | **0** | **1** | **2** | **3** |
|  | **Normal** | **Small amount of ocular discharge** | **Moderate amount of bilateral discharge** | **Heavy ocular discharge** |
|  |  |  |  |  |

Source: Linderoth, S. 2007. *Check calves from head to tail.* Dairy Herd Management.

[Available from: [http://www.dairyherd.com/directories.asp?pgID=724 &ed\_id=6219](http://www.dairyherd.com/directories.asp?pgID=724%20&ed_id=6219)]

Accessed 03 November 2008.

**Appendix 6 – Ear score**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Score** | **0** | **1** | **2** | **3** |
|  | **Normal** | **Ear flick or head shake** | **Slight unilateral droop** | **Head tilt or bilateral droop** |
|  |  |  |  |  |

Source: McGuirk. S. 2009. *Calf Health Scoring Chart.* University of Wisconsin. – School of Veterinary Medicines [Available from: <http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf>]

Accessed 19 September 2012.

**Appendix 7 – Faecal score**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Score** | **0** | **1** | **2** | **3** |
|  | **Normal** | **Semi-formed, pasty** | **Loose, but stays on top of bedding** | **Watery, sifts through bedding** |
|  |  |  |  |  |

Source: McGuirk. S. 2009. *Calf Health Scoring Chart.* University of Wisconsin. – School of Veterinary Medicines [Available from: <http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf>]

Accessed 19 September 2012.

**Appendix 8 – Calf health results**

Faecal scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 0.79 | 0.55 | 0.163 | NS |
| **Week 2** | 0.45 | 0.47 | 0.221 | NS |
| **Week 3** | 0.26 | 0.13 | 0.144 | NS |
| **Week 4** | 0.03 | 0.05 | 0.059 | NS |
| **12 weeks** | 0.00 | 0.00 | 0.00 | NS |

Hydration scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 1.05 | 1.08 | 0.057 | NS |
| **Week 2** | 1.00 | 1.00 | 0 | NS |
| **Week 3** | 1.00 | 1.26 | 0.026 | NS |
| **Week 4** | 1.00 | 1.00 | 0.00 | NS |
| **12 weeks** | 1.00 | 0.00 | 0.00 | NS |

Nasal scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 0.05 | 0.00 | 0.053 | NS |
| **Week 2** | 0.00 | 0.00 | 0.00 | NS |
| **Week 3** | 0.00 | 0.00 | 0.00 | NS |
| **Week 4** | 0.05 | 0.00 | 0.053 | NS |
| **12 weeks** | 0.00 | 0.08 | 0.058 | NS |

Ear scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 0.45 | 0.26 | 0.188 | NS |
| **Week 2** | 0.37 | 0.30 | 0.172 | NS |
| **Week 3** | 0.18 | 0.34 | 0.139 | NS |
| **Week 4** | 0.16 | 0.37 | 0.162 | NS |
| **12 weeks** | 0.21 | 0.16 | 0.149 | NS |

Eye scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 0.45 | 0.26 | 0.214 | NS |
| **Week 2** | 0.24 | 0.03 | 0.121 | 0.09 |
| **Week 3** | 0.24 | 0.11 | 0.132 | NS |
| **Week 4** | 0.24 | 0.13 | 0.139 | NS |
| **12 weeks** | 0.08 | 0.03 | 0.050 | NS |

Cough scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Starch** | **Fibre** | **s.e.d** | **Sig** |
| **Week 1** | 0.21 | 0.13 | 0.133 | NS |
| **Week 2** | 0.21 | 0.21 | 0.136 | NS |
| **Week 3** | 0.26 | 0.32 | 0.146 | NS |
| **Week 4** | 0.21 | 0.32 | 0.165 | NS |
| **12 weeks** | 0.24 | 0.08 | 0.112 | NS |