Long-term growth of cattle reared on a concentrate or forage starter diet

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Abstract

This study evaluated the feed cost and long-term growth of Wagyu x Holstein Friesian calves reared either on a forage starter (FS, ensiled Lucerne, \textit{Medicago sativa}; 45% DM, 19% CP, 9.7 MJ ME/kg DM) or a concentrate pelleted starter (CS; 90% DM, 19% CP and 13.8 MJ ME/kg DM) diet, followed by a forage-only diet. Calves (n=60) were allocated to either FS or CS diets and fed 2 L reconstituted whole milk/calf twice daily until week 7 and then once daily until week 9. Calves received their starter feeds \textit{ad libitum} until transferred to pasture (week 8), then starter feeds were removed gradually by week 15, thereafter all cattle were managed as one mob on forage. Calves consumed 80.3 kg DM for CS and 67.9 kg DM for FS diets. The CS calves had a 14 kg liveweight advantage over FS calves (P<0.001) at week 15. Thereafter, CS calves grew slower than FS calves to 10 months of age (0.44 vs. 0.52 kg/day; P<0.001), with similar liveweights between treatments from 10 to 26 months of age. The feed cost was $11 more per calf for CS than FS. Calves can therefore be reared at low cost on a forage based starter without compromising long term growth on pasture.

Keywords: calf rearing, economics, liveweight

Introduction

Calf diets vary in cost (Muir et al. 2000) and can have long-term consequences on cattle growth (Berge 1991). In New Zealand, calves originating from dairy farms are fed a milk-based diet, typically supplemented with concentrate to promote rumen development (Khan et al. 2016) and hence facilitate early weaning onto pasture. Inclusion of forage in the diets of concentrate fed calves improves their rumen development and promotes solid feed intake during and after weaning (Khan et al. 2011; Castells et al. 2013). However, the long-term growth of calves on pasture, after rearing exclusively on forage or concentrate starter diets is unknown. This study compared the economics of rearing calves either on a forage starter (FS, ensiled Lucerne, \textit{Medicago sativa}) or a pelleted concentrate starter (CS), and the effects on growth to two years of age in a pastoral system.

Materials and methods

This research was approved by the AgResearch Grasslands Animal Ethics Committee (AE12384) and conducted in compliance with the Animal Welfare Act of 1999 of New Zealand, and its amendments.

Wagyu x Holstein Friesian heifer calves (n=60, 4-14 days old) were sourced from two farms across three dates in August 2014. Calves were assigned to one of two dietary treatments (FS; forage starter or CS; concentrate starter), balanced for liveweight, arrival date and farm of origin. The CS calves received a 20% protein pelleted calf starter (Denver Stock Feeds, Palmerston North, New Zealand) and FS calves were fed FiberStart® (Modified Bio-Fermentation Lucerne high nutritional fiber HNF®; Fiber Fresh Feeds Ltd., Reporoa, New Zealand). Calves were housed in groups of ten with free access to fresh water. All calves were fed 2 L reconstituted whole milk powder (WMP) at 125 g/L twice daily for 7 to 9 weeks, reducing to once daily when individuals had gained a minimum of 18 kg liveweight, then were weaned off milk two weeks later. Calves had \textit{ad libitum} access to their respective solids feeds until one week after starting once-a-day milk feeding, when they were transferred to pasture. Solid feeds were...
gradually reduced over the following five weeks. All cattle were then managed in one group on a forage-based diet.

Solid feed DM intake was measured for each treatment from week 1 to 15 as the difference between refused and offered feed. Each batch of FS and CS feed was analysed for nutritional composition, via wet chemistry, by Hill Laboratories, Hamilton, New Zealand. Individual animal liveweight was measured on day 0, weekly until 16 weeks, fortnightly until 10 months then monthly until 26 months.

Economic margins for calf rearing were calculated as sale price at 15 weeks (when all calves had transitioned to a pasture only diet), minus feed costs and initial calf purchase price ($NZ150/calf). Sale price at 15 weeks was set at $NZ450 for a 90 kg calf, with an adjustment of ± $1.50 per kg liveweight above or below 90 kg (FirstLight Wagyu Ltd., New Zealand). WMP was priced at $NZ3500 per tonne and calf meal at $NZ800 per tonne. A comparison of commercial prices (https://store.nzfarmsource.co.nz) showed Fiberstart® averaged 90% of the cost of concentrate based pelleted calf starters and hence the Fiberstart® price was set at $NZ720 per tonne.

Statistical analyses were performed in R (R Core Team 2016) using a mixed effects model, with repeated measures for liveweight. Treatment was included as a fixed effect and source farm as a random effect. Arrival weight and date were used as covariates for analyses.

**Results and discussion**

The CS calves consumed an average of 28.3 kg WMP on a DM basis, compared to 29.8 kg for FS calves. The CS diet comprised 90% DM, 19% CP, 16.2% NDF and 13.8 MJ ME/kg DM, whilst FS comprised 45% DM, 19% CP, 40.3% NDF and 9.7 MJ ME/kg DM. Total DM intake of solid feed averaged 80.3 kg for CS calves and 67.9 kg for FS calves. The CS calves grew faster than FS up to week 15 (0.60 vs 0.48 kg/day, respectively, SEM 0.015, P<0.001), reflecting their greater DM intake and the greater ME content of their diet. This resulted in a 14 kg liveweight difference at 15 weeks, when solid feed was removed.

> Table 1. Liveweight (kg) of cattle reared on either a pelleted concentrate starter (CS) or a forage starter (FS) diet for up to 15 weeks, then grazed together on a forage diet.

<table>
<thead>
<tr>
<th>Age</th>
<th>CS</th>
<th>FS</th>
<th>Average SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 weeks</td>
<td>32</td>
<td>32</td>
<td>1.78</td>
</tr>
<tr>
<td>15 weeks</td>
<td>97</td>
<td>83</td>
<td>1.77***</td>
</tr>
<tr>
<td>5 months</td>
<td>117</td>
<td>107</td>
<td>1.80*</td>
</tr>
<tr>
<td>10 months</td>
<td>174</td>
<td>173</td>
<td>1.78</td>
</tr>
<tr>
<td>18 months</td>
<td>375</td>
<td>371</td>
<td>4.93</td>
</tr>
<tr>
<td>26 months</td>
<td>436</td>
<td>443</td>
<td>3.59</td>
</tr>
</tbody>
</table>

For differences between treatment means, * = P<0.05, *** = P<0.001.

Because of greater DM intakes, the cost of rearing was $NZ11 greater per calf for CS than FS. However, the profit during rearing was $NZ11 greater (SED 4.58, P<0.01) for CS than FS calves, due to their greater liveweight, and therefore higher sale price at 15 weeks ($NZ457 vs $NZ435, respectively, SED 3.65, P<0.001).

Following rearing, CS calves grew slower than FS calves to 10 months (0.44 vs 0.52 kg/day, respectively, SEM 0.014, P<0.001), with similar liveweight for both treatments from 10 to 26 months (Table 1). This could be due to either compensatory growth (Lawrence et al. 2012), or to the FS diet stimulating rumen development (Castells et al. 2013) to better prepare calves for a pasture-only diet. The similar liveweight of FS and CS cattle from 10 to 26 months indicates that the forage based starter diet could be used as a low cost option to rear calves for pastoral production systems without negatively affecting their long-term growth.
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References