The effects of using milk replacer on body growth and its economic feasibility in feeding dairy calves

R. A. El-jack\textsuperscript{1} and K. E. E. Ahmed\textsuperscript{2}

Faculty of Animal Production University of Khart Postal Code 13314, Khartoum, Sudan.

*Corresponding Author’s Email: kelabid@yahoo.com

ABSTRACT

Thirty-eight one day old female Holstein Friesian calves were raised on artificial rearing system. We are used in completely randomized design to evaluate the effects of using milk replacer on body growth and its economic feasibility. The results revealed that the pre-weaning weight gain, pre-weaning growth rate, weaning weight, post weaning growth rate and weight at final week (week twenty) of calves fed milk replacer was significantly higher (P<0.05) than that of calves fed raw milk. The cost of milk replacer given to calves groups was significantly (P<0.05) less than the cost of raw milk. The pre-weaning weight and post weaning weight benefits of calves fed milk replacer were significantly(P<0.05) higher than those of fed raw milk. The results on pre-weaning weights /cost ratio benefit revealed that the project would be beneficial and feasible for calves given milk replacer and not beneficial and economically feasible for calves given raw milk. Moreover, the results on post weaning weights /cost ratio benefit indicated that the project would be beneficial and economically feasible for all experimental calves.

Keywords: Calf rearing, Raw milk, Friesian calves, weight gain

INTRODUCTION

Information on calf growth and cost of calf rearing is important for cattle breeding and production and sustainability of any cattle enterprise depends upon the successful raising of calves for replacement stock. Several studies indicated that milk replacer had several benefits to the calf raiser and dairy producer, including consistency of product from day to day, ease and flexibility of storage, disease control, good calf performance and economics (Davis and Drackley, 1998; Compinis et al., 2002; Langhout, 2003; and wagenaar and Langhout, 2007).

Usage of milk replacer for feeding young dairy calves saving more milk for human consumption and sell to secure economic considerations (BAMN, 2002).

Nutritional research to improve calf rearing in the tropics is scarce and very little information is pertinent to performance of calves under artificial rearing is available and hence milk replacer is a very good source of liquid feed for calves, so it can be used instead of raw milk in calf rearing to avoid human competition for milk. So this study was therefore adopted to fill in this gap, with objectives of evaluating the effects of using milk replacer on calf growth and its economic feasibility.

Materials and methods

Thirty-eight female Holstein Friesian calves included in the trial were chosen from the borns of Azaheer Company farm. This farm is located at Elbagair about 40 km south of Khartoum. It lies on latitude (15° 23) N, longitude (32° 41) E, at the height 376 meters above sea level and extends on an area of 2300 hectares.

The area is characterized by sporadic rainfall during July-October. The ambient temperature in the site is high with an annual mean of 37.9C° and extremes of over 41.9 C°. The hottest months are May and June with a mean of about 41.2 C°. The lowest temperatures were
recorded in January with a mean of 22.4 °C. Mean temperature; Relative humidity and total rainfall in the area were shown in Table 1.

After calving the new born calves navels were treated with tincture of iodine, weighed, fed colostrums within the first 1 hour, ad-libitum and trained to drink from bucket feeding before separation from their dams. Then they were identified, placed in individual hutch for 15 days , after that they were assigned in birth order to two treatment groups each in separate pen.

Pens were kept clean and sanitized daily and bedding was changed regularly. The calf-barns were cleaned and fresh feed added every day, fresh water was provided daily in pails placed in each pen for the first 4 days, after that the calves were trained to drink from automatic fountains.

On day 15 calves were dehorned, injected with Multi vitamin and given internal parasite drench (Albendazol) every 2 weeks. All calves were weighed weekly.

The experimental calves were divided into two groups RM (Raw milk) and MR (Milk replacer). The RM group were fed raw milk at a rate of 10% body weight (Table 2), from day 6 to day of weaning. These calves in addition to milk replacer were given dry calf starter from day 4 until day of weaning. After day of weaning the calves were shifted gradually from dry calf starter to a concentrate mix with good quality hay which given ad-libitum until 20 weeks of age. (Table 3).

The birth weight of calves was taken immediately after birth and when the calves were dry. All calves were then weighted every week.

The pre-weaning average daily weight gain (PADWG) was calculated as follows:

$$PADWG = \frac{\text{Weaning weight} - \text{Birth weight}}{90 \text{ (weaning age in days)}}$$

The pre-weaning growth rate (PGR) was calculated as follows:

$$PGR = \frac{\text{Weaning weight} - \text{Birth weight}}{\text{Birth weight}}$$

The post weaning average daily weight gain (PWADWG) was calculated as follows:

$$PWADWG = \frac{\text{Weight at week 20} - \text{Weaning weight}}{50 \text{ (days)}}$$

The post weaning growth rate (PWGR) was calculated as follows:

$$PWGR = \frac{\text{Weight at week 20} - \text{Weaning weight}}{\text{Weaning weight}}$$

### Table 1. Some meteorological data of the region during the experimental period of the study.

<table>
<thead>
<tr>
<th>Month</th>
<th>Minimum</th>
<th>Maximum</th>
<th>R.H. %</th>
<th>R.F. mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2005</td>
<td>26.1</td>
<td>38.0</td>
<td>60</td>
<td>30.3</td>
</tr>
<tr>
<td>September 2005</td>
<td>27.3</td>
<td>39.4</td>
<td>48</td>
<td>Trace</td>
</tr>
<tr>
<td>October 2005</td>
<td>26.6</td>
<td>39.9</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>November 2005</td>
<td>21.1</td>
<td>36.2</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>December 2005</td>
<td>20.1</td>
<td>34.8</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>January 2006</td>
<td>22.4</td>
<td>35.0</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>February 2006</td>
<td>20.8</td>
<td>34.4</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>March 2006</td>
<td>21.8</td>
<td>37.4</td>
<td>13</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 2. The guaranteed analysis of the milk replacer and raw milk.

<table>
<thead>
<tr>
<th>Components</th>
<th>Milk replacer</th>
<th>Raw milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>22.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Crude fat</td>
<td>10.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>0.8</td>
<td>-</td>
</tr>
<tr>
<td>Ash</td>
<td>12.0</td>
<td>0.72</td>
</tr>
</tbody>
</table>
Table 3. Ingredients and constituent analysis of the diet fed during the pre-weaning and post weaning period.

<table>
<thead>
<tr>
<th>Components (%)</th>
<th>Dry calf starter</th>
<th>Concentrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut cake</td>
<td>25</td>
<td>36.3</td>
</tr>
<tr>
<td>Cotton cake</td>
<td>-</td>
<td>11.3</td>
</tr>
<tr>
<td>Sorghum Feterita</td>
<td>35</td>
<td>11.3</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>37</td>
<td>36.3</td>
</tr>
<tr>
<td>Ca(_2)CO(_3)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Salt</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dry matter</td>
<td>96.4</td>
<td>97.2</td>
</tr>
<tr>
<td>Crude protein</td>
<td>24.3</td>
<td>22.3</td>
</tr>
<tr>
<td>Crude fat</td>
<td>3.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>13.2</td>
<td>14.3</td>
</tr>
<tr>
<td>Ash</td>
<td>7.9</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Table 4. Pre-weaning live weight gain of calves.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Feeding regime</th>
<th>MR</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADWG (kg) SE±</td>
<td>0.61±0.01(^a)</td>
<td>0.56±0.01(^b)</td>
<td></td>
</tr>
<tr>
<td>PGR SE±</td>
<td>1.59±0.05(^a)</td>
<td>1.47±0.07(^b)</td>
<td></td>
</tr>
<tr>
<td>Weaning weight (kg) SE±</td>
<td>89.63±1.57(^a)</td>
<td>85.42±1.78(^b)</td>
<td></td>
</tr>
</tbody>
</table>

The benefit of weights/cost ratio (B/C) was calculated as follows:

\[
\text{B/C} = \frac{\text{Discounted gross benefit}}{\text{Discounted gross cost}}
\]

Whereas:

If the ratio equal one or more than one, the project was accepted economically.
If the ratios lower than one, the project was un accepted economically.

Meteorological data

Meteorological information on temperature, relative humidity and rainfall at the time of investigation were collected from Sudan meteorological authority. (Table 1).

Statistical analysis

Mean, standard error and correlation coefficient of different traits were computed. Analysis of variance was carried out by using the completely randomized design. Duncan's multiple range test was used with factor that had significant effect on the traits studied. All techniques of statistical analysis were conducted using the computer program statistical package for social sciences (SPSS 13, 2001).

RESULTS

Pre-Weaning calves growth

Pre-Weaning Average Daily Weight Gain

The data in Table 4 indicated that calves fed milk replacer grew faster than calves fed raw milk.

a and b Means in the same row followed by same superscript are not significantly different (P>0.05), PADWG = Pre-weaning average daily weight gain, PGR = Pre-weaning growth rate.

Pre-weaning growth rate

As seen in Table 4 pre-weaning growth rate of calves fed milk replacer was higher (P<0.05) than pre-weaning growth rate calves fed raw milk.

Weaning weight

The data in Table 4 indicated that calves that were fed with milk replacer had 6.6% more weaning weight than calves that fed raw milk.
Table 5. Post-weaning live weight gain of calves.

<table>
<thead>
<tr>
<th>Supplements Feeding</th>
<th>PWADWG (kg)</th>
<th>PWGR</th>
<th>W.W.20 (kg)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM</td>
<td>0.70±0.02</td>
<td>0.65±0.17</td>
<td>135.78±2.02</td>
<td>19</td>
</tr>
<tr>
<td>MR</td>
<td>0.92±0.02</td>
<td>0.89±0.10</td>
<td>165.73±2.77</td>
<td>19</td>
</tr>
</tbody>
</table>

a and b: Means in the same column followed by same superscript are not significantly different (P>0.05), PWADWG = Post-weaning average weight gain, PWGR = Post-weaning growth rate, W.W.20 = Weight at week twenty.

Table 6. Pre-weaning and post weaning total cost of calves rearing.

<table>
<thead>
<tr>
<th>Factors: Nutritional supplements</th>
<th>RM</th>
<th>MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding regime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of RM ($/head)</td>
<td>223a</td>
<td>-</td>
</tr>
<tr>
<td>Cost of MR ($/head)</td>
<td>-</td>
<td>106.9 b</td>
</tr>
<tr>
<td>Cost of DCS ($/head)</td>
<td>20.1 a</td>
<td>13.4 b</td>
</tr>
<tr>
<td>Cost of concentrate($/head)</td>
<td>24.3 a</td>
<td>17.7 b</td>
</tr>
</tbody>
</table>

a, b: Means in the row followed by same superscript are not significantly different (P>0.05). SP = Sudanese Pound, RM = Raw Milk, MR = Milk Replacer, DCS = Dry Calf Starter.

Post-Weaning calves growth

Post-Weaning Average Daily Weight Gain

The data in table 5 indicated that there were differences (P<0.05) between post weaning weight gain of MR calves and RM calves.

Post-Weaning Growth Rate

The results in table 5 indicated that calves of MR group had 36.9% more post-weaning growth rate than calves of RM group.

Weight At Week Twenty

As seen in table 5 the weight at week twenty of MR group was highly significantly different from that of RM group.

Economic Feasibility

Pre-weaning cost of calves rearing

As seen in table 6 the cost of rearing of MR calves was significantly less than RM animals.

The results in table 6 also indicated that the average cost of dry calf starter of MR calves was significantly less than RM animals.

Cost of concentrate during the post weaning period

The average cost of concentrate of RM calves was significantly higher than MR animals, (Table 6).

Benefit of calves weights

Pre-weaning benefit of experimental calves weights

The data in Table 7 demonstrated that MR calves had significantly greater value of pre-weaning weights benefit compared to RM calves.

Pre-weaning benefit of weights / cost ratio

The RM calves attained higher value of pre-weaning benefit of calves weights/cost ratio than RM calves, this result indicated that the project would be beneficial and feasible for RM calves and not beneficial and feasible for RM animals, (Table 7).

Post weaning benefit of experimental calves weights

As seen in table 7 the average post weaning benefit of RM calves weight was significantly lower than MR animals.

Post weaning benefit of weights / cost ratio

The results in table 7 indicated that the post weaning benefit of calves weights /cost ratio of MR calves was
higher than RM animals. Although of that the project would be beneficial and feasible for all experimental calves.

**DISCUSSION**

The pre-weaning weight gain obtained by calves fed milk replacer was significantly (P<0.05) higher than that obtained by calves fed raw milk. This may be attributed to the highly nutritious value of milk replacer compared to the raw milk. This gain was higher than that reported by Terosky *et al.* (1997), Blome *et al.* (2000) and Compinis *et al.* (2002). The high result obtained in this study may be due to tremendous improvement of manufacturing milk replacer in late years. On the other hand, the reported results for the calves reared on milk replacer in this study were lower than that reported by Tikofsky *et al.* (2001), Langhout (2003) and Ito, *et al.* (2006). This might be attributed to that; those workers carried their experiments in temperate climate where low temperature increased metabolism. The present result showed that MR calves grew faster than RM calves. This finding typically agreed with Bartlett *et al.* (2002). The weaning weight of calves fed milk replacer was significantly greater than the weaning weight of calves fed raw milk. The value mentioned in this study was higher than that reported by Godden *et al.* (2003). On the other hand, the study value of this research was lower than the values mentioned by Langhout (2003) and Wagenaar and Langhout (2007).

The post-weaning weight gain calculated in this study was higher than that reported by Langhout (2003) and Yanar *et al.* (2005). From the other side the result of the work was lower than that claimed by Jasper and Weary (2002) and Ito, *et al.* (2006). The calves fed milk replacer had significantly higher weight at week twenty, than calves fed raw milk. The study value was higher than that obtained by Compinis *et al.* (2002).

The present result showed that the cost of rearing of MR calves was significantly less than that of RM calves. These findings typically agreed with Jaster *et al.* (1990).

The pre-weaning cost of raw milk and milk replacer for rearing of calves group calculated in this study agreed with Colvin *et al.* (1968) and BAMN (2002). While the pre-weaning cost of dry calf starter of calves given milk replacer was significantly less than that of calves given raw milk. The study value was lower than that obtained by Quigley *et al.* (2006). The pre-weaning cost of dry calf starter of calves given milk replacer was significantly less than that of calves given raw milk, this might be attributed to that calves given milk replacer consume less dry calf starter than those given raw milk. These findings typically agreed with Hodgson 1971 and Huber *et al.* 1984, and disagreed with Richardson and Oliver (1979).

**CONCLUSIONS AND RECOMMENDATIONS**

Rearing dairy calves with milk replacer gave better calf performance than with whole milk in terms of calf growth and economic feasibility.

The good performance of calves and economic feasibility of usage of milk replacer must be disseminated to dairy farmers by extension services.

**REFERENCES**


Blome RM, Drackley JK, McCoy GC, Davis CL, McKeith FK (2000). Effects of Protein Content in Milk Replacers on...


