Effect of variable dietary energy level on dry matter intake, milk production and milk composition of early lactating Friesian cows

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Abstract
The aim of the study was to evaluate the effect of three different dietary energy levels on dry matter intake, milk production and composition of early lactating Friesian cows at University dairy farm Peshawar. Nine multiparous early lactating (10±5days in milk) cows were selected and divided into three groups with three animals in each group with three dietary energy levels, (E-100%), (E-88%) and (E-112%); respectively. High DMI (P<0.05) was recorded for diet E-112 (13.78±0.17kg/day) followed by diet E-100 (13.14±0.12kg/day). Significantly high milk yield (14.80±0.10lit/day) was observed in diet E-112 and lower milk yield (13.01±0.10kg/day) for diet (E-88%). High milk fats (3.91±0.02%) were found at low energy diet and no statistical difference found among other composition of milk. It was concluded that diets containing high dietary energy above than the recommended ME level by NRC for early lactating cows can increase DMI and milk yield under local environment of Peshawar.

Keywords: dietary energy, DMI, milk production, milk composition

1. Introduction
During early lactation, the dietary energy requirements of high yielding dairy cows for maintenance and milk production exceed the amount of energy obtained from dietary sources. Thus, the high energy requirement at the onset of lactation results in a negative energy balance (NEB) that begins a few days pre-partum and usually reaches its maximum two weeks post-partum [4]. Traditional system of raising animals either by grazing or by providing poor quality roughages with or without any supplementation is not satisfactory to meet the nutrient requirement of high milk producing animals particularly energy, protein and minerals [27]. In nutritional needs of dairy animals postpartum, energy is one of most critical nutrients which may affect production performance. Earlier studies [9] and [8] reported that sufficient dietary energy is an important factor in high lactating animals which may prevent negative energy balance and other metabolic disorders. Increase in milk yield of dairy cows that results from their genetic improvement requires the use of large amounts of concentrates: forage ratios that are rich in energy and crude protein (CP) to meet their nutrient requirements [7]. Dairy feed in terms of both availability and nutritive value is the most important constraint affecting productivity of dairy cows [2].

Lactating animals fed low energy diet may able to produce equal quantity of milk than diets at or above NRC recommendations, but decline rapidly after few weeks of lactation [11]. In Pakistan, dairy cows are mostly fed on low quality roughages and crop residues, which are poor in energy, protein, minerals and vitamin contents [10]. Keeping in view that the availability of common feed sources is seasonal and is mostly of poor quality to support high milk production of high yielding animals. Milk composition of cow is very important for the dairy industry. Several nutritional management strategies have been proposed to increase energy intake during early lactation. Feeding high quality forages, an increase in dietary energy concentration of ration, increasing the concentrate: forage ratio, or adding supplemental fat to diets are some of the most common ways to improve energy intake in cows. On the basis of above facts the current study was designed to evaluate the effect of three different dietary energy levels on milk yield and composition of early lactating dairy cows.
2. Materials and Methods
Current study was conducted in the months of March to May 2013. For this study, nine early lactating multiparous Holstein Friesian cows (BW 400±10kg) were selected for the experiment from the University of Agriculture Peshawar Dairy Farm Malakandeer. The experimental animals were divided into three groups randomly (each group consists of three cows) named A, B & C under completely randomized design. The animals were assigned to three dietary energy based treatments one was NRC recommended level (100 %) ME and diet B ME level (88%) and diet C high ME level (112%) DM basis were provided to their respective animals in a group. The total mix ration (TMR) diets were formulated as Iso-nitrogenous (CP 16%) having varying dietary energy levels. The diets were fed twice daily in the morning and evening to individual animals and the feed refused were measured next morning to determine daily feed intake expressed in (DMI), the experiment was last for seventy-four days (74) including adaptation period. Feed intake of each animal was individually recorded daily; DMI [8] was calculated as percent dry matter in feed consumed multiplied by feed consumed for all the experimental groups. Milk production was recorded daily and milk samples were collected weekly for milk composition. Milk sample (100 ml) was taken from each cow for determination of Milk fat (%), solids not fat (SNF), Milk protein and lactose (%) contents with the help of Lactoscan (auto analyzer machine) at Center of Animal Nutrition, Livestock Research and Dairy development (LR&D) Peshawar, Khyber Pakhtunkhwa. Concentrates and berseem samples were analyzed for proximate composition, NDF, ADF and in vitro digestibility at laboratory of Animal Nutrition University of Agriculture Peshawar before the start of experiment and during provision to the dairy cows. Proximate analyses of feed samples were done according to Association of Official Analytical Chemists [3] while NDF and ADF were performed according to [33] in the Laboratory of Animal Nutrition given in Table 1.1. Digestible nutrients and ME were calculated by the following formulas after determination of TDN value of the feed sample.

\[
\text{DE (Mcal / kg DM)} = \text{TDN\%} \times 0.04409
\]
\[
\text{ME (Mcal / kg DM)} = (1.01 \times \text{DE})-0.45.
\]

Statistical Data analyses
Data were analyzed by using the GLM procedure (Proc GLM; SAS®, Version 8.02; SAS Institute Inc., Cary, NC) as described by [31]. Effects of factors were declared significant at P<0.05. The model given below was adopted to study the effect.

\[
Y_{ij} = \mu + \tau_i + \epsilon_{ij}
\]

Where

\[
Y_{ij} = \text{The i-th observation on j-th animal}
\]

\[
\mu = \text{over all sample mean,}
\]

\[
\tau_i = \text{Effect of i-th treatment (energy level)}
\]

\[
\epsilon_{ij} = \text{treatment error}
\]

3. Results
The effect of different dietary energy levels on Dry matter intake, Milk production and milk composition in early lactating Holstein Friesian cows are given in Table 1.2. Mean dry matter intake of the dairy cows was increased significantly with increasing energy concentration in the diet (p<0.05). High DMI (13.78 kg/day) was observed for high energy diet C (112%) followed by diet B- 100% (13.14) and A-88 (12.68 kg/day) showed in Table 4.1. There was a significant difference (P<0.05) found for Milk yield between dietary treatments, high yield was recorded at Diet C (14.80±0.10 lit/day) followed by treatment A (14.06±0.15), respectively, while low milk yield was observed (13.01±0.10 kg/day) for diet having less dietary energy than the recommended level of NRC. Dietary treatment has a significant effect on milk fats as high milk fats (3.91±0.021) percentage was found at low energy dietary treatment B followed by A (3.75±01) and C (3.58±0.03), whereas no statistical difference P>0.05 were observed in between treatments for rest of milk composition. Although milk protein (3.5±0.07) and milk lactose (4.77±0.03) were found numerically high at diet C. The level of solid not fat were not significantly different >0.05, in between treatments.

4. Discussion
In postpartum dairy cows optimum performance in term of dry matter intake and Milk yield was achieved in the diet which is having high energy than the NRC recommended level for dairy cows. This study confirms that the NRC recommendations for dairy cows are not suitable for early lactating cows in environment of Pakistan, therefore further it need an extra energy in diet for early lactating cows above NRC recommended levels ME (112%) to attain high milk yield/animal and DMI after postpartum. Reason for that might be due to the difference in animal physiological status, breed of animal, dietary ingredients and its nutritive composition, Available feed, environmental changes and other management practices.

Varying dietary energy levels significantly influenced (P<0.05) DM intake and milk yield in early postpartum cows. The results of the present study are in line with findings of Vazquez-Anon et al. (1997) who reported that increasing dietary energy density in rations improved DM intake of dairy animals. In agreement to our results [23] reported a greater DMI (11.30 kg/day) for high energy diet (1.70Mcal NEL/kg) while 10.5 kg/day for low energy diet (1.58 Mcal NEL/kg). [16] Stated that DMI was slightly increased (4.84, 4.90, 4.93 kg/day) in Sahiwal heifers fed with different energy diet (80, 100 and 120% ME) in tropical environment. While, diet low in energy (E-80) is a detrimental effect on dairy cows’ milk production that decreased quickly. There was a significant difference (P<0.05) found for Milk yield between dietary treatments, high yield was recorded at Diet C (14.80±0.10 lit/day) followed by treatment A and B respectively. Current finding of the study are supported by some researcher works like [16, 28, 23, 32, 24, 10], reported that high energy diet significantly increased milk yield than low ME diet in post partum cows [17], also observed similar results that cows which were on high-energy group produced slightly more milk than the low energy diet. Current study was really in line with [16] observed that the contents of milk protein, lactose, solids not fat and total solids were not influenced (P>0.05) by varying dietary energy levels in lactating Nili-Ravi buffaloes followed by the findings of [1] who concluded that enriched dietary energy and protein, with varying milking frequency did not affect milk protein percent. Likewise [17], also found that milk composition was not affected by feeding an energy-rich diet (added dietary fat) to Holstein cows. This study was supported by the data of [30] and [26] where he found no significant differences regarding milk protein content between different types of diets and feeding period [13]. Found little increase in milk protein
concentration with increasing dietary energy intake but not statistically significant (P>0.05) among the treatments. Milk protein reflects the balance of dietary protein and energy intake \[29, 7\]. Suggested that milk protein can be used as an indicator for energy intake, because it responds to the energy supply level of the dairy cows up to some extent. However, \[34\] who studied the effect of high energy diet during mid to late lactation milk protein yield. This may be due to difference in lactation stage and the proportion of protein in the diet.

### Table 1.1: Ingredients and nutrient composition of experimental ration

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>A - (100 %)</th>
<th>B - (88 %)</th>
<th>C - (112 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton Seed Cake</td>
<td>06</td>
<td>12</td>
<td>04</td>
</tr>
<tr>
<td>Maize oil cake</td>
<td>04</td>
<td>04</td>
<td>11.2</td>
</tr>
<tr>
<td>Wheat Bran</td>
<td>18</td>
<td>18</td>
<td>7.2</td>
</tr>
<tr>
<td>Maize Glutton (20%)</td>
<td>04</td>
<td>3.2</td>
<td>08</td>
</tr>
<tr>
<td>Maize grain</td>
<td>04</td>
<td>00</td>
<td>06</td>
</tr>
<tr>
<td>Mustard seed cake</td>
<td>3.2</td>
<td>02</td>
<td>2.8</td>
</tr>
<tr>
<td>Dicalcium Phosphate</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Berseem</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Wheat Straw</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>CP%</td>
<td>15.99</td>
<td>16.02</td>
<td>16.01</td>
</tr>
<tr>
<td>ME M-cal/kg</td>
<td>2.50</td>
<td>2.10</td>
<td>2.90</td>
</tr>
<tr>
<td>NDF %</td>
<td>46</td>
<td>49</td>
<td>41</td>
</tr>
<tr>
<td>ADF</td>
<td>26</td>
<td>21</td>
<td>29</td>
</tr>
</tbody>
</table>

Values having different superscripts within same row are significantly different (P<0.05).

### Table 1.2: Effect of different dietary energy levels on dry matter intake, milk production and composition of early lactating Holstein Friesian cows.

<table>
<thead>
<tr>
<th>Description</th>
<th>A (100 %)</th>
<th>B (88 %)</th>
<th>C (112 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM intake (kg/day)</td>
<td>13.14±0.12</td>
<td>12.68±0.11</td>
<td>13.78±0.17</td>
</tr>
<tr>
<td>Milk yield (kg/day)</td>
<td>14.05±0.15</td>
<td>13.01±0.01</td>
<td>14.80±0.10</td>
</tr>
<tr>
<td>Body weight (Kg)</td>
<td>7.00±1.73b</td>
<td>23.00±0.57b</td>
<td>-9.00±0.57c</td>
</tr>
<tr>
<td>Milk Composition (%) Fats</td>
<td>3.75±0.01</td>
<td>3.91±0.02</td>
<td>3.58±0.03</td>
</tr>
<tr>
<td>Protein</td>
<td>3.52±0.04</td>
<td>3.51±0.01</td>
<td>3.55±0.13</td>
</tr>
<tr>
<td>Lactose</td>
<td>4.75±0.02</td>
<td>4.73±0.11</td>
<td>4.77±0.01</td>
</tr>
<tr>
<td>Total Solid</td>
<td>12.71±0.07</td>
<td>12.80±0.14</td>
<td>12.57±0.17</td>
</tr>
<tr>
<td>Solid not fats</td>
<td>8.93±0.12</td>
<td>8.96±0.15</td>
<td>8.99±0.11</td>
</tr>
</tbody>
</table>

5. Conclusion

After postpartum optimum performance in term of dry matter intake and Milk yield was achieved at diet having high dietary energy (112%) for early lactating Holstein Friesian cows than the NRC recommended level. The reason for that may be the difference in animals’ physiological status, breed of dairy animal, dietary ingredients and its nutritive composition, environmental changes and other management practices. By providing high energy diet in dense form can reduce risk of negative energy balance and other nutritional factors. It will ultimately improve animal health and production and economy of the poor farmers.

6. Acknowledgement

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7. References


