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**Research Article – Veterinary Science and Medicine**

# Feeding values of conventional diets and their effects on the performances of dairy cows in Central Myanmar

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## Abstract

The conventional diets have been fed to dairy cows since many years ago in Myanmar, however there is a little scientific information regarding the use of those diets as feed. Therefore, this study was conducted to evaluate the feeding values of conventional diets and their effects on the performances of dairy cows in Central Myanmar. Nine cross-bred Holstein Friesian cows (460±22kg) with the 12$^{th}$ week of lactation were randomly allocated to one of three treatment groups with three replicates in a completely randomized design. The three treatments were Diet-ST (common diet from Sin Tel, Tatar U Township), Diet-MN (common diet from Myay Ngu, Tatar U Township) and Diet-AM (common diet from Amarapura Township). Cows were fed treatments for 60 days. The roughage to concentrate ratios ranged from 53:47 to 72:28 and the nutritive values were significantly different ($p<0.05$) each other. The highest nutrient intakes were observed in dairy cows fed on Diet-MN, however the nutrient digestibility were not different ($p>0.05$) except the CP and ether extract digestibility (CPD and EED). The nitrogen utilization was highest in dairy cows fed on Diet-ST and the lowest value was observed in the dairy cows fed on Diet-AM. Although the milk compositions were not different ($p>0.05$), the average milk yield of dairy cows offered the Diet-MN was significantly higher ($p<0.05$) than those of dairy cows fed on other diets. The highest total feed cost ($p<0.05$) was found in Diet-AM and the lowest value ($p<0.05$) was in Diet-MN. According to these findings, it was concluded that the highest feeding value was observed in Diet-MN and its effect on the performances of dairy cows was also greater than others. Moreover, it would be suggested that better bean residues and sesame residues could be used as fibre sources in the diets of dairy cows.

*Key words:* Conventional diets, dairy cows, digestibility, nitrogen utilization, milk yield

## Introduction

Dairy production is a biologically efficient system that converts large quantities of roughage to milk, an important place in human diet. Among the avenues of food production of animal origin in the developing countries, smallholder dairy production systems are potentially very important because of their rapid expansion, strong market orientation in rural area (Devendra, 2001) and poverty alleviation, food security, improved family nutrition, income, and employment generation (Uddin *et al.,* 2012). Most of smallholder dairy farmers in the developing countries had been used the crop residues and agricultural by-products for their dairy cattle. Khan *et al.* (2009) also reported that the traditional feeding system for dairy cattle is based on the use of rice straw, natural grasses supplemented with a little or no concentrates. Thus, the performances of dairy cattle might be reduced with the inadequate nutrition and unbalanced ration offered to those cattle.

Like as other developing country, the national economy of Myanmar is also oriented on the agriculture and livestock sectors. Most of people, about 70% of national population, live in rural area and they rely on those sectors for their livelihood. Moreover, in Myanmar, some of

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livestock farmer are landless and some are land holder. The landless livestock farmers mainly depend on the roadside grass and conventional tree forages for their ruminant animals and the land holder livestock farmers depend on the crop residues and agricultural by-products from their agriculture. Although locally available conventional feedstuffs such as agriculture by-products and crop residues are used as feed for dairy cattle, the information concerning the nutritive and feeding values of those feeds and their effect on the performances of dairy cattle were still limited.

According to the report of Aung *et al.* (2015a), a survey of conventional feed resources and milk production level of dairy cows in Central Myanmar, the milk production of dairy cows from Myay Ngu region was higher than those of Sin Tel and Amarapuraregions. It is thus needed to evaluate the nutritive values and feeding values of conventional feeds offered to dairy cows in those regions. As the results of *in vitro* and *in situ* nutritional evaluation of conventional feeds, the higher nutritional potentials were observed in most conventional feedstuffs (Aung *et al.,* 2015b) and the different nutritional quality such as effective net gas, fermentation kinetics, partitioning factor, *in vitro* dry matter digestibility (Aung *et al.,* 2016), degradation kinetics and the energy protein synchronization (Aung *et al.,* 2015c) were found in conventional diets. However, it is still crucial to determine the feeding values of conventional dietsand their effect on the performances of dairy cows. Therefore, this study was intended to evaluate the feeding values of conventional diets and their effects on the performances of dairy cows in Central Myanmar.

## Materials and methods

### *Experimental animals and diets*

Prior to the experiment, the animals were fed on the experimental diets for 2 weeks to become adaptation to those diets. Nine cross-bred Holstein Friesian cows (460±22 kg) in the 12$^{th}$ week of lactation were randomly allocated to one of three treatment groups with three replicates/treatments in a completely randomized design. The three treatments (conventional diets) were Diet-ST (common diet from Sin Tel village, Tatar U Township), Diet-MN (common diet from Myay Ngu village, Tatar U Township) and Diet-AM (common diet from Amarapura Township). The ingredient and chemical compositions of experimental diets were presented in Table 1 and Table 2, respectively. The conventional diets were offered two times a day (08:00 AM and 16:00 PM) and the drinking water was freely accessed. Cows were fed treatments for 60 days and the digestion trial was made at the last 5 days of the experimental period.

### *Measurements*

During the feeding trial, all of the feedstuffs were weighed and sampled before feeding. Moreover, milk yield was also recorded three consecutive days in one week. Milk was analyzed once in every two weeks with Lactoscan. During collection period, milk samples, feedstuffs offered samples and refused (orts) samples were collected for chemical analysis. The orts were weighed and sampled before morning feeding and then removed. Faeces voided and urine outputs were recorded daily during the collection period.

### *Chemical analysis*

Ground samples of feed offered, residues (orts), and faeces were analyzed for DM, organic matter (OM) and ether extract (EE) by the method described by AOAC (1990) and analyzed for neutral detergent fibre (NDF) and acid detergent fibre (ADF) by Goering and van Soest (1970). Nitrogen were analyzed by using Kjeldahl method (Fross 2020 digester and Foss 2100 Kjeltec distillation unit) and CP was calculated as 6.25 x N (AOAC, 1990).

### *Statistical analysis*

The data were subjected to the analysis of variance (ANOVA) and the significance of differences between treatments means were compared by Duncan's Multiple Range Test (DMRT) using SPSS (version 16.0) software.

## Results

### *Nutrient intake*

The daily nutrient intakes (metabolic size per body weight) of dairy cows offered experimental diets are presented in Table 3. The nutrient intakes [dry matter intake (DMI), organic matter intake (OMI), crude protein intake (CPI), neutral deterg–

**Table 1.** Ingredient compositions (%) of experimental diets

| Conventional feedstuffs | Experimental diets | | |
|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM |
| Rice straw | 23 | 21 | 33 |
| Sorghum stover | 14 | _ | 9 |
| Sesame residue | 25 | _ | _ |
| Natural grass | _ | 17 | 11 |
| Butter bean residue | _ | 34 | _ |
| Cottonseed cake | 29 | 20 | _ |
| Broken rice | 8 | 8 | 7 |
| Chickpea mill | _ | _ | 40 |
| Roughage: Concentrate | 63:37 | 72:28 | 53:47 |

All ingredient compositions are on DM basis.

**Table 2.** Chemical compositions (%) of experimental diets

| Chemical Compositions | experimental diets | | | SEM | P Value |
|---|---|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM | | |
| DM | 58.94$^{a}$ | 53.99$^{b}$ | 46.70$^{c}$ | 2.05 | 0.001 |
| OM | 90.98$^{a}$ | 90.27$^{a}$ | 88.12$^{b}$ | 0.41 | 0.038 |
| CP | 16.09$^{a}$ | 16.46$^{a}$ | 11.46$^{b}$ | 0.74 | 0.001 |
| NDF | 60.62$^{ab}$ | b59.07$^{c}$ | 61.26$^{a}$ | 0.62 | 0.001 |
| ADF | 40.05$^{b}$ | 34.74$^{c}$ | 47.98$^{a}$ | 1.47 | 0.001 |
| EE | 1.94 | 2.06 | 1.78 | 0.05 | 0.112 |

$^{a,\ b,\ c,:}$Means within the same row with various superscripts are significantly different. SEM: standard error mean. All values except DM are on DM basis.

**Table 3.** Nutrient intakes of dairy cows offered experimental diets (g/kg BW$^{0.75}$)

| Descriptive | Experimental diets | | | SEM | P Value |
|---|---|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM | | |
| DMI | 107.67$^{ab}$ | 122.00$^{a}$ | 100.01$^{b}$ | 3.99 | 0.036 |
| OMI | 95.33$^{ab}$ | 107.67$^{a}$ | 87.33$^{b}$ | 3.55 | 0.029 |
| CPI | 20.33$^{a}$ | 19.33$^{a}$ | 14.67$^{b}$ | 0.92 | 0.001 |
| NDFI | 71.33$^{ab}$ | 78.67$^{a}$ | 64.33$^{b}$ | 2.61 | 0.050 |
| ADFI | 54.67$^{b}$ | 63.33$^{a}$ | 51.33$^{b}$ | 2.14 | 0.028 |
| EEI | 2.35$^{a}$ | 2.19$^{a}$ | 1.92$^{b}$ | 0.07 | 0.015 |

DMI: dry matter intake, OMI: organic matter intake, CPI: crude protein intake, NDFI: neutral detergent fibre intake, ADFI: acid detergent fibre intake and EEI: ether extract intake; $^{a,\ b,\ c}$; Mean value with different superscripts with the same row are significantly different ($p<0.05$).

**Table 4.** Digestibility of nutrients (%)

| Descriptive | Experimental diets | | | SEM | P Value |
|---|---|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM | | |
| DMD | 59.33 | 57.33 | 52.67 | 2.27 | 0.534 |
| OMD | 62.67 | 60.33 | 58.00 | 1.96 | 0.687 |
| CPD | 66.67$^{a}$ | 62.00$^{ab}$ | 53.00$^{b}$ | 2.58 | 0.050 |
| NDFD | 57.33 | 55.33 | 55.44 | 2.31 | 0.850 |
| ADFD | 55.00 | 51.00 | 52.33 | 2.16 | 0.794 |
| EED | 53.67$^{a}$ | 43.00$^{b}$ | 42.67$^{b}$ | 2.30 | 0.050 |
| TDN | 56.73 | 54.37 | 51.88 | 1.78 | 0.606 |
| DCP | 12.81$^{a}$ | 9.91$^{b}$ | 7.81$^{c}$ | 0.79 | 0.003 |

DMD: dry matter digestibility, OMD: organic matter digestibility, CPD: crude protein digestibility, NDFD: neutral detergent fibre digestibility, ADFD: acid detergent fibre digestibility and EED: ether extract digestibility, TDN: total digestible nutrients, DCP: digestible crude protein; $^{a,\ b,\ c}$; Mean value with different superscripts with the same row are significantly different ($p<0.05$).

–ent fibre intake (NDFI), acid detergent fibre intake (ADFI) and ether extract intake (EEI)] of dairy cows fed on Diet-MN were significantly higher ($p<0.05$) than those of dairy cows fed on Diet-AM. The nutrient intakes of dairy cows fed on Diet-ST were not statistically different ($p>0.05$) with the dairy cows fed on Diet-MN and Diet-AM.

**Table 5.** Nitrogen utilization (g/kg $BW^{0.75}$) of dairy cows fed on experimental diets

| Descriptive | Experimental diets | | | SEM | P Value |
|---|---|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM | | |
| Nitrogen intake | 3.32[a] | 3.12[a] | 2.34[b] | 0.15 | 0.001 |
| Faecal nitrogen | 1.10 | 1.19 | 1.06 | 0.05 | 0.587 |
| Urine nitrogen | 0.84[a] | 0.59[b] | 0.51[b] | 0.06 | 0.039 |
| Nitrogen utilization | 1.38[a] | 1.34[a] | 0.77[b] | 0.12 | 0.026 |

[a, b]; Mean value with different superscripts with the same row are significantly different ($p<0.05$)

**Table 6.** Milk composition (%) of dairy cows fed on experimental diets

| Descriptive | Experimental diets | | | SEM | P Value |
|---|---|---|---|---|---|
| | Diet-ST | Diet-MN | Diet-AM | | |
| Fat | 3.91 | 4.37 | 3.95 | 0.25 | 0.759 |
| Solid Not Fat | 8.22 | 7.96 | 8.09 | 0.18 | 0.876 |
| Density | 29.02 | 27.66 | 28.52 | 0.58 | 0.691 |
| Protein | 3.01 | 2.93 | 2.96 | 0.07 | 0.875 |
| Conductivity | 6.13 | 5.39 | 5.88 | 0.16 | 0.137 |
| Salt | 0.67 | 0.65 | 0.66 | 0.02 | 0.903 |
| Lactose | 4.51 | 4.35 | 4.44 | 0.09 | 0.832 |

**Table 7.** Average milk yield (4% FCM) and feed cost effectiveness (kyat/Kg feed) of dairy cows fed on experimental diets

| Experimental diets | Cost for feed (kyat) | | | Average milk yield (4% FCM) (Kg) | Feed cost (kyat*)/ Kg of milk |
|---|---|---|---|---|---|
| | Roughage | Concentrate | Total | | |
| Diet-ST | 437[a] | 1446[b] | 1903[b] | 6.35[b] | 300.65[b] |
| Diet-MN | 425[a] | 1245[c] | 1670[b] | 7.55[a] | 221.00[c] |
| Diet-AM | 339[b] | 2373[a] | 2712[a] | 5.75[c] | 474.43[a] |
| SEM | 16.06 | 172.88 | 142.21 | 0.28 | 34.23 |
| P Value | 0.001 | 0.001 | 0.007 | 0.001 | 0.001 |

[a, b, c]; Mean value with different superscripts with the same column are significantly different ($p<0.05$); * kyat (Myanmar currency): 1 US dollar is equivalent to 1250 kyat.

Therefore, the lowest nutrient intake was found in dairy cows fed on Diet-AM and the highest intake was observed in dairy cows fed on Diet-MN.

*Digestibility of nutrients*

The digestibility of nutrients, total digestible nitrogen (TDN) and digestible crude protein (DCP) are shown in Table 4. Although most of digestibility of nutrients were not significantly different ($p>0.05$) among the experimental diets, it was noted that crude protein digestibility (CPD) of Diet-ST was significantly higher ($p<0.05$) than that of Diet-AM. The ether extract digestibility (EED) of Diet-ST was 53.67% and significantly higher ($p<0.05$) than those of other diets. Although TDN of all experimental diets were not significantly different ($p>0.05$) each other, DCP of Diet-ST was significantly higher ($p<0.05$) than those of other diets (Diet-MN and Diet-AM), in which the lowest DCP value ($p<0.05$) was observed in Diet-AM.

*Nitrogen utilization*

The nitrogen utilizations of dairy cows fed on experimental diets were described in Table 5. In which, nitrogen intake, urine nitrogen and nitrogen utilization of dairy cows fed on Diet-ST were significantly higher ($p<0.05$) than that of the dairy cows fed on Diet-AM, however, it was not different ($p>0.05$) with the dairy cows fed on Diet-MN. However, faecal nitrogen was not different ($p>0.05$) among the dairy cows which were offered the experimental diets.

*Milk composition*

Milk compositions of dairy cows fed on experimental diets are expressed in Table 6. Although all compositions of milk were not different ($p>0.05$) among the experimental dairy cows, the milk fat content of Diet-AM was tended to be higher than those of other.

*Average milk yield (4% FCM) and feed cost effectiveness (kyat/ Kg feed)*

The average milk yield (4% FCM) and feed cost effectiveness (kyat/Kg feed) of the dairy cows offered the experimental diets were presented in Table 7. The highest milk yield ($p<0.05$) was observed in dairy cows fed on Diet-MN and the lowest yield ($p<0.05$) was found in dairy cows offered the Diet-AM. The total feed cost for Diet-AM was significantly higher ($p<0.05$) than those for other diets, Diet-ST and Diet-MN which were not significantly different ($p>0.05$) from each other. The feed cost per Kg of milk was found to be highest ($p<0.05$) in Diet-AM and the lowest cost was found in Diet-MN.

**Discussions**

The highest nutrient intakes were observed in dairy cows fed on Diet-MN compare with the cows fed on other diets. It might be due to the different ingredient composition of experimental diets commonly fed to dairy cows. The butter bean residue and greater amount of natural grass were included in the composition of Diet-MN. The natural grass is lush and it could stimulate the appetite of the animals, which result the increased feed intake. Concerning the bean residue, these might contain the easily digestible fibre, which also improved the feed intake of the animals. Ososanya *et al.* (2013) also found that the increasing levels of cowpea husk in the diets could increase the DM intake of animals. Moreover, Ngwe *et al.* (2012) and Fuma *et al.* (2012) suggested that bean husk supplementation, especially lablab bean husk, might improve the nutritive value of rice straw diet by stimulating fibrolytic bacteria and other associated bacteria. Another reason for the variation of feed intake for dairy cows was the partitioning factor (PF) for the microbial protein synthesis (MPS) efficiency which was highest in Diet-MN (Aung *et al.,* 2016). Blummel *et al.* (1999) recommended that roughage with higher PF has been shown to have higher DMI. It might be due to the increased passage of microbial protein to the small intestine which result the increased passage of both fluids and solids with increased intake (Gomes *et al.,* 1994; Djouvinov and Todorov, 1994).

Although most of digestibility had no differences among the experimental diets except the CPD, in which the lowest CPD was observed in Diet-AM. According to the report of Aung *et al.* (2016), it was noted that the lowest partitioning factor (PF) for microbial protein synthesis (MPS) efficiency was also found in Diet-AM among the experimental diets. Not only digestibility of DM but also that of CP was correlated with the efficiency of microbes in the rumen. Therefore, improved efficiency of microbes was considered as the most important target to maximize MPS, while synchronization of carbohydrate and protein supply in the rumen had been suggested as one possible solution to achieve that target (Kaswari *et al.,* 2006). The reason for the wide difference of DCP was the variation of DMI, CPI and CPD among the conventional diets. Those values of Diet-ST were higher in compare with other diets. Concerning the aspect of TDN, although no difference was found among the experimental diets, the values of TDN of three diets (56.73, 54.37 and 51.88 %, respectively) were lower than the level recommended by NRC (2001).

The CPI, nitrogen intake, nitrogen excretions (Faecal and urine nitrogen) and nitrogen utilization were lowest in the dairy cows fed on Diet-AM. Conversely, the highest value was found in the dairy cows fed on Diet-ST. It was recognized that the main factor influencing the excretion of N from dairy cows was protein intake, and there was a very strong and positive relationship between manure N output and dietary protein intake (Yan *et al.,* 2010).

The differences were not found in the milk compositions of dairy cows offered the experimental diets, however, the highest value of milk fat was observed in the dairy cows fed on Diet-MN. This might be due to variation of inclusion level of roughage and concentrate in the ration and fibre intake (NDFI and ADFI). The higher inclusion levels of forage in the ration and fibre intake were found in Diet-MN and the lowest was observed in Diet-AM. Milk fat concentration was affected by the amount of fibre, the forage-to-concentrate ratio, carbohydrate composition of concentrate mix, lipids, intake, and meal frequency (Sutton, 1989).

The average milk yield of dairy cows offered the Diet-MN was significantly higher than those of dairy cows fed on other diets. The reason for this finding was due to the different values of rumen degradable protein (RDP), un degradable protein (UDP) and energy protein synchronization of experimental diets. The higher values of those parameters were observed in the Diet-MN (Aung *et al.,* 2015c).The microbes used the ammonia (available from RDP and urea recycling), amino acid (AA) and peptides in conjunction with available carbohydrates for their growth. They were part of the rumen outflow, and microbial protein might contribute more than 50% of the protein flowing to the small intestine (Clark *et al.,* 1992). A deficiency of RDP lead to poor microbial growth reducing microbial protein synthesis, carbohydrate digestion and feed intake, and consequently milk production (Schwab and Boucher, 2005).

The highest total feed cost was found in Diet-AM and the lowest value was in Diet-MN. It might be due to the variation of inclusion level of forages and concentrate in the diet composition. The inclusion level of roughages was highest in Diet-MN and lowest level was found in Diet-AM. Conversely, the inclusion of concentrates was highest in Diet-AM and lowest value was observed in Diet-MN which gave the highest average milk yield. It could be assumed that the roughages used in Diet-MN could be high quality forages. Many researchers stated that using of high quality forage increased the production with low input cost. On the other hand, the higher amount of concentrates used in the Diet-AM caused the impaired energy protein synchronization which resulted low milk production (Lardy *et al.,* 2004; Elseed, 2005; Schwab and Boucher, 2005).

## Conclusions

The nutrient intakes were highest in the dairy cows fed on Diet-MN and the lowest intake was found in cow fed on Diet-AM. The TDN and DCP value of Diet-AM was lower in compare with Diet-ST and Diet-MN. For the nitrogen utilization, the higher values were found in dairy cows fed on Diet-ST and Diet-MN, and the lowest value was observed in Diet-AM. The average milk yield of dairy cows fed on Diet-MN was higher than those of dairy cows fed on other diets. Moreover, the lowest total feed cost and feed cost per Kg of milk were observed in Diet-MN. According to these findings, it was concluded that the highest feeding value was observed in Diet-MN and its effect on the performances of dairy cows was also greater than others. Moreover, it would be suggested that better bean residues and sesame residues could be used as fibre sources in the diets of dairy cows.

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