Journal of Animal and Veterinary Advances 11 (2): 165-170, 2012
ISSN: 1680-5593

Assessment of Potential Milk Production of Chinese Hesitan

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Abstract: This study was aimed to assess a potentiality of milk production for a recently established dairy farm. A total of 201 Chinese Hesitan cows and 21 calves were raised in stall feeding system. The cows were respectively divided into area A (lactating only), B (late pregnant only), C (early pregnant only) and D (calves only). The study period lasted for 60 days which initially involved only 19 lactating cows and ended with 102 lactating cows. Physical observation of daily milk collection (twice daily); routine feeding and management operations had been maintained throughout the period of the study. Purposive or judgment sampling technique was employed. Sample of milk was collected for laboratory analysis at the beginning, middle and end of the study to determine its composition in terms of milk fat and solid not fat percentage. Data collected were collated and analyzed using Microsoft Excels 2007 for simple descriptive statistics and application of computer packages SSPS 17 for analysis. The total milk yield for the period of 60 days for the study was 43177.7 kg. The average milk yield was 719.63 kg while the milk sold was 38,578 kg. The relationship between the daily milk production and the number of lactating cows showed that the observed data values have strong relationship with the quadratic model-predicted value. The study result revealed that the BW average was 482 kg and BCS means for lactating and dry cows was 2.98 while calving weights for calf male and female were 37.69 and 33.60, respectively. Milk nutrients composition of milk fat, milk protein, lactose and DM means were 3.85, 3.59, 4.54 and 12.57, respectively. The correlation between the concentrate, the forage fed to the lactating cows and the feed efficiency dry matter intake indicated that there was a significant relationship ($p<0.01$). It was recommended that silage should be included in the feeding system because it contains qualitative nutrients.

Key words: Milk production, lactating cow, feed intake, forage, concentrate, Nigeria

INTRODUCTION

Milk production is a livestock enterprise in which small-scale farmers can successfully engage in order to improve their livelihoods. With world population projected to increase by 50% to 8.8 billion by 2030, the ability to adequately feed people will face growing challenges (Brown and Kane, 1994). The demand for meat and milk will increase by 2.9 and 3.2% $annum^{-1}$, respectively in the developing world between 1993 and 2020 (Bradford, 1999; Delgado *et al*., 1999).

In 2005, there were some 115 million dairy farms in 73 countries for which the International Farm Comparison Network IFCN has detailed information. Based on this number, IFCN estimated a total number of dairy farms in 2005 of 149 million considering all countries. It is assumed that the average farm household comprises 5-6 persons about 750-895 million people or 12-14% of the world population, directly depend to some extent on dairy farming. World cow's milk production in 2008 stood at >578 million tons with the top ten producer countries accounted for 55.4% of production. Milk production in an implied manner is the product of the number of dairy cows and the productivity per cow so, growth in milk production is the result of changes in these two components (Fuller *et al*., 2006). Improved nutrition is the most important and most feasible way to increase animal productivity to meet the anticipated demand for meat and milk.

However, the changes in dairy cows' milk production and milk composition throughout the lactation are well known. Dryden reported that milk yield rises to a peak early in the lactation and then falls gradually (at about 10% $month^{-1}$) while milk fat and protein contents are initially high, fall to their lowest point at the time of peak yield then gradually rise throughout the rest of the lactation. However, lactose content remains more or less constant throughout the lactation (McLdryden, 2008).

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The objective of this study was to assess a potentiality of milk production for a recently established dairy farm in Northeast of China, Heilongjiang province. Findings from this study will contribute in the area of nutrition which in turn addresses food security and provision of goods and services. The relevance of the study will assist livestock and feeds enterprises by revealing up to date information that will help in the development and improvement of dairy milk production.

MATERIALS AND METHODS

A total of 201 Chinese Hesitan cows (which consist of 19 lactating cows, 182 pregnant cows both early and late pregnant) and 21 calves were raised in Monggaoli Nanyang dairy farm in stall feeding system (although, the number keeps changed as a result of calving). The cows were respectively divided into area A (lactating only), B (late pregnant only), C (early pregnant only) and D (calves only). Physical observation of daily milk collection (twice daily); routine feeding and management operations had been observed and maintained throughout the period of the study; simply it is cross sectional study. Purposive or Judgment sampling technique was used as it is relatively easier and cheaper and ensures that only those elements that are relevant to this research are included (lactating cows).

The records of important parameters includes daily feed intake of concentrate (bought from manufacturer) and forage (Leymus Chinese hay, commercial name Yangcao hay) were fed to the cows based on their physiological status requirements. Daily milk yield milk was collected twice 1:00 a.m. and 2:00 p.m., respectively. Other management activities; average weight of cows, body scoring condition and calving weight had been recorded from the farm record book. Sample of milk was collected for laboratory analysis at the beginning, middle and end of the study. Milk samples were analyzed for fat, protein and SNF at the Animal nutrition laboratory of Yili Industrial Group Company Limited by using infrared spectrometry (Multispec Mark I®; Foss Food Technology, Eden Plains, MN).

Proximate analyses of sample of Leymus Chinese fed to the lactating cows were conducted at Animal Science Laboratory of South China Agricultural University according to AOAC (1990) for determination of DM, CP, ADF and NDF (Van Soest *et al*., 1991). In addition, the documented figures from Ministry of Agriculture Beijing were also recorded for comparison. While for concentrate, nutrient compositions where recorded from manufacturer's pamphlets.

Data collected were collated and analyzed using Microsoft Excels 2007 for simple descriptive statistics on feeding and milk production and application of computer packages SSPS 17.0 in 2008 for correlation and regression analysis.

RESULTS AND DISCUSSION

Milk production: The total milk yield for the period of 60 days for the study is 43,177.7 kg. The average milk yield is 719.63 kg. The milk sold is 38,578 kg. Table 1 shows detailed description of the milk production. The relationship between the daily milk production in kilograms and the number of lactating cows is shown in Fig. 1. It showed that the observed data values have strong relationship with the quadratic model-predicted data value. Lateef *et al*. (2008) conducted the study at dairy and cattle improvement farm, Hathazari, Chittagong for a period of 1 year.

A total of 82 dairy cows were selected during the period and their information regarding milk production up to 180 days revealed that average milk production (459.09±138.09 L) and birth weight of fetuses (18.78±34 kg) were observed.

Comparatively, this present study which recorded one third of the total days of Lateef's milk production shown high average milk yield; thus was due to increase in number of lactating cows almost daily and the total period of the study were fall within the first lactation phase.

McLdryden (2008) indicated that milk yield rises to a peak early in the lactation and then falls gradually (at about 10% month^{-1}).

Table 1: Milk production statistics

Milk production statistics	N	Range	Minimum	Maximum	Sum	Mean Statistic	Mean SE	SD	Variance
DYMILK[a]	60	1192.00	237	1429.00	43178.00	719.630	49.0040	379.5850	144084.835
DYMILK Avg[b]	60	4.74	11.52	16.26	838.84	13.980	0.1707	1.3200	1.740
Milk sold	60	1102.50	162.5	1265.00	38578.50	642.975	46.0560	356.7490	127270.224
Colostrums	60	74.00	0.00	74.00	1600.00	26.667	2.4723	19.1501	366.725
Under Med[c]	60	164.00	0.0000	164.00	2834.70	47.250	4.1890	32.4450	1052.673
Waste[d]	60	13.50	0.0	13.50	152.50	2.542	0.5413	4.1927	17.579

[a]Daily yield milk in kg; [b]Average daily yield milk in kg; [c]Milk collected from lactating cows under medication (treatment) ; [d]Milk contaminated (not use for human consumption)

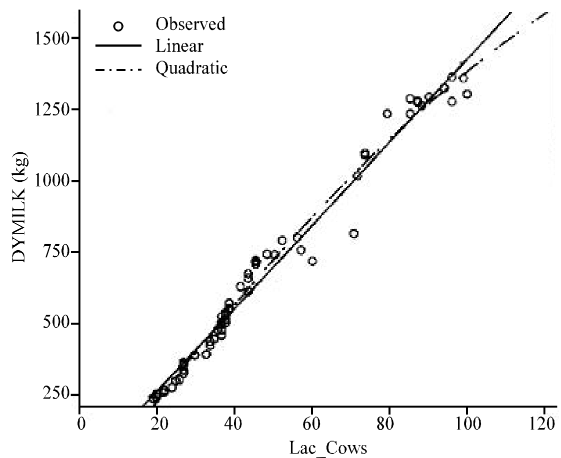

Fig. 1: The relationship between the daily milk yield and the no. of cows; Where: DYMILK = Daily Yield Milk; Lac_cows = No. of Lactating cows

Table 2: Body weight, body condition score and calving weight

Parameter observed	Range	Average	Remarks
Body weight (kg)	430-534	482.00	Weighing prior to purchase
Body condition score	1.75-4.20	2.98	Obtained by 2 independent evaluators
BCS for lactating cows	1.75-2.75	2.25	Same as above
BCS for Heifers	3.70-4.20	3.95	Same as above
Calving weight (kg)			
Female calves	25-44	33.60	Calves delivered within the period of the study and weighed immediately
Male calves	25-48	37.69	After birth

Productive record: An adequate body condition is very important for the maintenance of an animal's production, reproduction and overall health. Improving body condition score to the optimum increases fertility whereas excessive condition can result in metabolic problems. In this study, BW and Body Condition Score (BCS) were determined prior to purchase and should be continue periodically. Table 2 shows body weight, body condition score and calving weight.

The average body weights were between 430-500 kg. The average BCS of the lactating cows were between 1.75-2.75 while BCS were initially obtained by two independent evaluators, using the scoring system based on a 5-point scale (1 = Very thin to 5 = Very fat) (Wildman *et al.*, 1982).

Feeding for body condition is very important to reduce the incidence of health problems. It has been suggested that a 1% increase in the variation of dry matter intake increases the likelihood of post-calving incidents by 4% (McGuffey *et al.*, 1997). According to Garcia and Hippen (2008), body condition scoring is useful and it is a practical visual assessment tool of the nutritional status

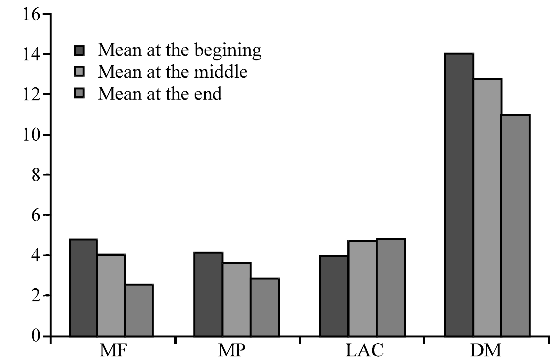

Fig. 2: Sample milk nutrient contents. Where: MF = Milk Fat; MP = Milk Protein; LAC = Lactose and Dry Matter = DM

of cattle. High percentages of repeatability both between measurements and between scorers can be obtained with practice. They added that for the 1st 4-6 weeks after calving, the cow's feed intake does not increase as fast as milk production does which results in the mobilization of body stores.

Thus, during the 1st 2 months of lactation, the extent to which a cow will lose body condition is determined by the balance between her nutrient uptake and her genetic potential for milk production. According to the NRC (2001), the equilibrium between tissue mobilization and accretion in an adequately fed cow can occur at approximately 60 days post-calving.

Achieving this equilibrium as soon as possible is of importance because of the related increases in the percent of cows that resume ovarian cyclic activity. The scoring system usually in use for dairy cattle is a 5-point scale with 1 corresponding to an extremely thin cow and 5 to a cow with excessive fat deposits (Wildman *et al.*, 1982). Sample collection and analysis: Milk production was electronically recorded at each milking.

Milk from different cows was sampled at the beginning, middle and the end of the study. Individual a.m. and p.m. samples were analyzed for fat, protein and SNF at the Animal Nutrition Laboratory of Yili Industrial Group Company Limited by using infrared spectrometry (Multispec Mark I®; Foss Food Technology, Eden Plains, MN).

Figure 2 shows that the MF, MP and DM averagely decreased from the beginning to the end of the study while that of LAC averagely increased. Although, this study ended within first phase of lactation, it has proved the statement from McLdryden (2008) that stated milk fat and protein contents are initially high, fall to their lowest point at the time of peak yield and then gradually rise throughout the rest of the lactation but lactose content remains more or less constant throughout the lactation.

Similarly, Soriano (1998) recorded milk fat (3.47) and protein percentage (3.23) when Holstein cows in mid lactation were used that fed either a TMR diet only or were fed TMR during half of the day (after the a.m. or p.m. milking) and supplemented with grazing pasture during the other half of the day.

Feeding to the lactating cows: As earlier stated at the beginning of this study there were 19 Chinese hesitan cows but ended with 102 cows. There are two types of feeds; concentrate CP≥20 and forage CP 5.4 (Leymus Chinese hay) were fed to the lactating cows. The concentrate nutrients composition and L. Chinese hay proximate analysis results were shown in Table 3-5 while Table 6 shows detailed description of the feeding to the lactating cows including the dry matter intake, dry matter intake average and feed efficiency dry matter intake per head per day.

The relationship between the daily milk yield and the concentrate fed to lactating cows Fig. 3 shows that the daily milk yield responded positively to the concentrate fed to lactating cow for the period of 60 days for the study. The observed data values have strong relationship with the model-predicted values.

Similarly, Fig. 4 shows the relationship between the daily milk yield and the forage fed to lactating cows. It indicated that the daily milk yield responded positively to the forage fed to lactating cow for the period of 60 days for the study.

However, the response is not as high as that to concentrate; this may be due to the fact that the forage has low nutrients composition (Table 3-5). The relationship between the daily milk yield and dry matter intake which shows the feed efficiency dry matter intake per head per day (Fig. 5).

Figure 5 shows that there is strong relationship between the observed data values and the quadratic model predicted data values. Therefore, the higher the dry matter intake in relation to daily milk yields, the lower the feed efficiency dry matter per head per day.

Previous research by Garcia and Hippen (2008), reported that early in lactation, feed efficiency for milk production is artificially high and results from a low initial feed intake paired with body fat mobilization. As a result, once feed intake starts to increase in the 1st 2 months of lactation, the feed efficiency for milk production sharply decreases (hand-in-hand with increased feed intake) and feed efficiency continues to decrease through the remainder of the lactation.

After the 8 weeks of lactation, the energy supplied by the feed tends to match that required for milk production. At this time, the cow starts to gain condition whereas feed efficiency for milk production continues to drop steadily.

Additionally, improving feed efficiency without taking a close look at body condition can thus negatively impact fertility, productivity and overall animal health. The

Table 3: Composition of Leymus Chinese (Yangcao) hay

Nutrient name	Nutrient content (%)
DM	93.34
CP	5.38
CF	31.33
NDF	67.40
ADF	45.20
DE (MJ kg^{-1})	6.75

Animal Science Laboratory, South China Agricultural University, Guangzhou, 2011

Table 4: Nutrient composition of concentrate fed to lactating cows: Product nutrition analysis value (%)

CP	CF	Ash	Ca	Total	Salt	Lysine	Moisture
≥20	≤12	≥12	0.7-2.5	p≥0.4	0.3-2.5	≥0.5	≤14

Table 5: Major trace element and essential vitamins per kg of feed

Zn	Fe	Cu	Mn	Vitamin A (IU)	Vitamin D_3 (IU)	Vitamin E
≥100	≥15	12-35	≥100	≥14000	≥4500	≥15

Main raw materials; soybean meal, corn, powder, dicalcium phosphate, salt, vitamin A, vitamin D_3, vitamin E, choline chloride, zinc sulfate, ferrous sulfate, copper sulfate, manganese sulfate, lysine; Manufacturer's formulation information provided on feed bags, 2011

Table 6: Feeding statistics

						Mean			
Feeding statistics	N	Range	Minimum	Maximum	Sum	Statistic	SE	SD	Variance
ConcLCow[a]	60	625.800	130.200	756.000	22054.300	367.572	24.625	190.746	36383.849
For LCow[b]	60	830.500	171.500	1002.000	27061.000	451.017	32.975	255.422	65240.419
DM LCow[c]	60	1225.670	305.200	1530.870	43419.870	723.665	49.803	385.774	148821.941
DMLCowA[d]	60	21.550	11.770	33.320	1399.160	23.319	0.7741	5.996	35.953
FdEFy DM[e]	60	1.230	0.880	2.110	68.910	1.149	0.0354	0.274	0.075

[a]Concentrate fed to Lactating cows in kg; [b]Forage fed to Lactating cows in kg; [c]Dry matter intake for Lactating cows in kg; [d]Average dry matter intake for lactating cows in kg; [e]Feed efficiency of dry matter intake per head/cow

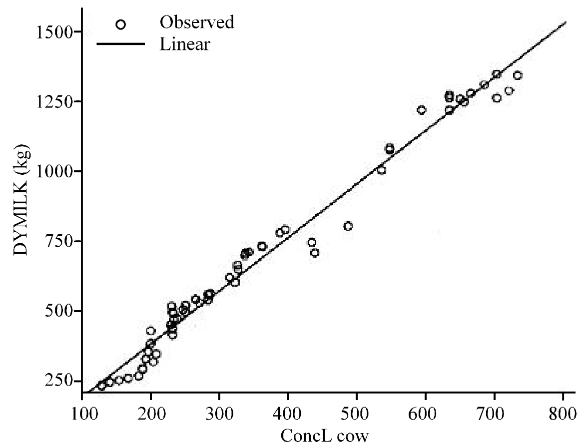

Fig. 3: The relationship between the daily milk yield and the concentrate fed to lactating. Where: DYMILK = Daily Yield Milk; ConcLcows = Concentrate fed to Lactating cows

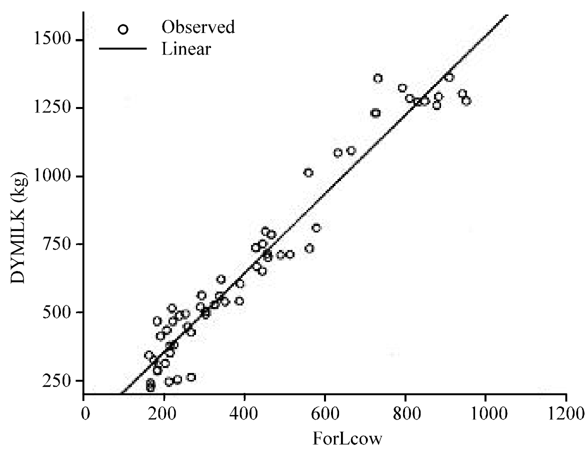

Fig. 4: The relationship between the daily milk yield and the forage fed to lactating. Where: DYMILK = Daily Yield Milk; ForLcows = Forage fed to Lactating cows

correlation between the concentrate, the forage fed to the lactating cows and the feed efficiency dry matter intake indicated that there is a significant relationship ($p<0.01$).

Although, Rearte *et al*. (1986) observed an increase in milk yield when cows were supplemented with concentrate plus hay in this present study there will be a tendency of decrease in milk yield as the observed data values shown strong relationship with quadratic model predicted data values. Thus, continual feeding with Yangcao hay may lead to decrease in milk yield.

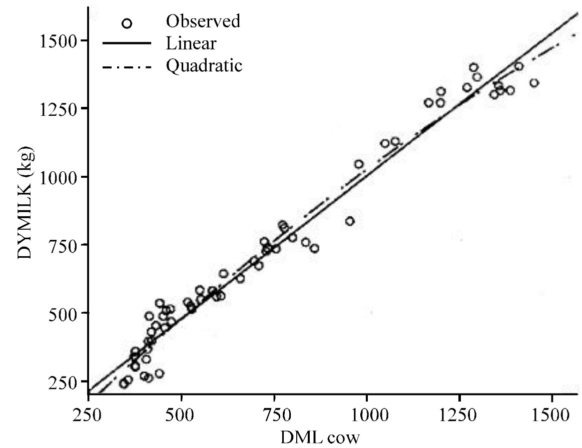

Fig. 5: The relationship between the daily milk yield and the dry matter intake fed to lactating cows; where: DYMILK = Daily Yield Milk; DMLcows = Dry matter intake of Lactating cows

CONCLUSION

Based on the present finding, it was recommended that silage should be included in the feeding system because it contains qualitative nutrients. It is well known that the primary goal of ensiling forages has been to conserve the maximum amount of original dry matter, nutrients and energy in the crop for feeding afterward. On the other hand, all daily routine feeding and management aspects should be regularly reviewed and improved. Future research should employ Animal nutrition models that accommodate more dairy parameters to predict milk production.

ACKNOWLEDGEMENTS

The researchers would like to extend appreciation to College of Animal Science, South China Agricultural University for funding the research and heartfelt thanks to Monggaoli Nanyang Dairy Farm where this study was conducted.

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