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## Effect of different milking methods and frequency on milk yield, composition and udder health of Holstein Friesian cattle

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### Abstract

The present study was performed to identify the effect of different milking methods and frequencies on milk yield, composition and health of Holstein Friesian cattle at Government Dairy Farm (GDF) Quetta. Sixteen pure Holstein Friesian cattle breed lactating animals were selected according to their age, body weight and lactation period. They were divided into four groups i.e. A, B, C and D with four cows in each group. Research work was conducted on dry matter in-take (DMIT), milking frequencies, milking practices (both hand and machine milking), animal behavior, milk composition (fats and solids not fats) and cost of milk production aspects in light of factual prevalent rates. Results on group mean values indicated that DMIT in groups A, B, C and D was  $16.63 \pm 0.53$  kg to  $16.74 \pm 0.55$  kg for all experimental animals, out of the total of 38 kgs feed/fodder, daily per cow. As a whole total dry matter in-take depicted 25-26%. The effect of milking frequencies on milk yield was significant. In hand milking the mean values of milk yield in group A and B was 15.5 and 15.72 liters respectively; while machine milking twice 17.38 liters group C or thrice 17.74 liters group D were significantly different ( $P < 0.05$ ) as the machine milked cows thrice give comparatively high production. Percentage of milk fat composition in group averages recorded as  $4.14 \pm 0.14$ . These values of hand milking in group B was  $3.89 \pm 0.07$ . In group C the mean values were  $3.98 \pm 0.06$  and in group D these fat values were  $3.95 \pm 0.16$  respective. Results regarding mean values of milk solid not fats in group A, B, C and D were  $9.72\% \pm 0.17$ ,  $9.70\% \pm 0.05$ ,  $9.46\% \pm 0.11$  and  $9.46 \pm 0.08$  respectively. These results show that practices and frequencies of milking did not have any significant effect on milk yield fats and / or SNF. Cost of milk production (based on cost of green fodder @ Rs. 150/-, Concentrate feed @ Rs 200/-, wheat straw Rs.25/-). With a highest milk production yield 17.74 liters milk fetched Rs. 106.4/- @ Rs. 60/- per liter.

**Keywords:** Milking method, milk yeild, Holstein Friesian cattle, dry matter-intake

### 1. Introduction

Livestock play most important role in the farming and rural economies of the developing countries. The farm animals, an imperative sub-sector of agriculture plays pivotal role in the economy of all agricultural countries and Pakistan. Balochistan is the largest province of Pakistan in term of area, which contributes total 45% surface of the country. Being an arid and semi arid province, livestock rearing is the major source of income of the province. Almost 1.5 million of the population is involved directly or indirectly in livestock production [1]. Those animal population did not full fill need of country that's why government decided to import the exotic breed of dairy cattle Holstein Friesian to enhance the milk production [2].

The zoological name of Holstein Friesian is *Bos Taurus*. This is the exotic breed and originated from Friesland and Holland, with body color of white with black patches or white with red patches. Calf weight is 90 pounds while mature male and female weight 1000 kg and 550-650 kg, respectively. It can be bred at 15 month of age having gestation period of nine months. Milk production is 7200-9000 liters per lactation with 3.5% fat and 3.15% protein. These were imported to meet the milk demands of the developing countries like Pakistan way back a decade ago [3].

Two milking practices (i) Machine milking and (ii) Hand milking are being practiced in Pakistan. By Machine milking, the milk yield can be increased which has valuable sound effects on udder health [4, 5]. Machine milking does not affect the composition such as fat and / or Solid Not Fat (SNF) [6].

Furthermore, machine milking has many advantages over hand milking, the productivity can be increased significantly as well as providing better results in terms of quantity and quality of milk obtained. On the other hands, manual milking placed a great strain on hand in which there are chances of damage to udder or rough handling of cows [7]. Machine milking can affect the udder health but the affect strongly depends on the exposure to pathogens, mastitis and the quality of the milk [8]. Furthermore, milking frequencies three times per day to increase milk yield has been shown by up to 14% compared to milking only twice per day [9]. Similarly, fat % has been reported to increase in two times with hand milking as compared to three times with machine [10].

Keeping in view these facts, the present study was conducted to compare the milking practices i.e. Manual and Machine and their effects on milk yield, composition (fat and solid not fat), udder health and cost of milk production in Holstein Friesian Cattle Farm Quetta.

## 2. Material and Methods

### 2.1. Place of Work

The present study was carried out at Government Dairy Farm Quetta and Lasbela University of Agriculture, Water and Marine Sciences.

The GDF Quetta was established in the year 1977 with the objectives to provide the dwellers of the city, provide the elite class of animals, and to train the progressive for livestock farmers and modern dairy farming practices. For this purpose 100 pure Holstein Friesian cattle were imported from Denmark. In the time of present study, total animals 127 out of these 40 cows were in milk, 3 dry, 14 pregnant, 54 heifers

in different age, 02 bulls, 14 suckler male and female (7:7). Lasbela University of Agriculture, Water and Marine Sciences Uthal was established in 2005 and this university distributes the different degrees. Doctor of veterinary Medicines is one of these degrees which were registered from PVMC Islamabad in 2012. Feed and milk samples were tested in Animal Nutrition and Animal Production Technology Laboratory.

### 2.2. Experimental animals and treatment groups

The animals selected from GDF Quetta in which Sixteen (16) lactating Holstein Friesian (HF) cows were in the same lactation, of same body weight and body conditions score. These animals were divided into four equal groups A, B, C, D, in each group there were four animals. Milking was carried out by hand and machines milking methods twice, thrice in a day. The duration of experiment was for a period of 60 days.

### 2.3. Animal Health Care

Experimental animals were kept in separate pens. Cows were vaccinated against diseases and were treated for internal and external parasites before the start of experiment. Before milking mastitis test (surf test reference by Muhammad *et al.* 2010) were performed throughout the study period and teats of animals, milking machine utensils and buckets were washed with disinfectants.

### 2.4. Milking Practice

The layout of milking practices throughout the study period is given in (Table No 01).

**Table 1:** Distribution of cow's two different groups and frequency.

Groups	Treatments			
	A	B	C	D
Frequency	Twice	Thrice	Twice	Thrice
Timing	6.00 AM & 6.00 PM	6.00 AM, 2.00 PM & 10.00 PM	6.00 AM & 6.00 PM	6.00 AM, 2.00 PM & 10.00 PM
Milking Method	Manual	Manual	Machine	Machine

### 2.5. Feeding of animals

(a) The detail of experimental feed is in Table No-02 The green fodder feed was offered to all animals @10% of their Body Weight (B.Wt) while concentrate feed was offered @8

Kgs to each animal at 9:00 am and 5:00 pm, facility of fresh drinking water were available 24 hours for all treatment groups .

**Table 2:** Mixed chopped fodder plus concentrate offered to the experimental animals at GDF, Quetta.

S#	Feed Ingredient	Percentage inclusion	Dry Matter percentage
1	Green Fodder	70%	23.20%
2	Wheat Straw	5%	98.90%
3	Concentrate	25%	93.59%
I	Cotton seed cake	40%	93.93%
II	Wheat Bran	40%	94.32%
III	Rice Polishing	10%	92.5%
IV	Crushed pea foliage	09%	93.6%
4	Di-Calcium Phosphate(DCP)	01%	0
5	Rock Salt (Lick Block)	-	-

### 2.6. Feed samples

Feed samples were collected from feed offered through the study period for determining the dry matter.

### 2.7. Milk samples

80 fresh milk samples (15 ml) were collected (20) from each group (A, B, C, and D) in 15 ml falcon tube. The samples were collected after every 15 days.

### 2.8. Laboratory analysis of Milk sample Fats and solid not fats (SNF)

For determination of fat% the procedure of Garber Method (Kleyn *et al.*, 2001) and for SNF the Hot Water Bath technique was used at Animal Products and Technology Laboratory, Lasbela University Agriculture, Water and Marine Sciences Uthal.

### Statistical Analysis

The collected data were statistically analyzed using T test and Analysis of variance (ANOVA) technique as per required treatments (Steel *et al.* 1997). The statistical analysis software (SAS, 2004) and (Duncan 1995) was used for this purpose.

### 3. Results

#### 3.1 Dry matter intake (DMI)

The result of milking technique on waterless substance intake is given in table 03. The results show that DMI is statistically similar ( $P>0.05$ ) in all groups. However, comparatively greater dry matter intake was recorded on twice milking frequency and lowest was observed in case of thrice.

#### 3.2 Milk Production:

The influence of milking methods on milk yield at two times of milking frequencies is presented in table 04. The results revealed that the milk yield obtained on machine milking is maximum ( $P<0.05$ ) than manual milking method in morning and evening times. In the machine method, the evening milk yield was significantly higher ( $8.86^a \pm 0.70$ ) than morning milk yield ( $8.52^b \pm 0.06$ ). Similar trend was observed in case of the manual method.

The effect of three time milking frequencies on milk yield is given in table 05. The results indicate that milk yield is maximum ( $P<0.05$ ) on machine milking than manual milking method. Among all (morning, noon, evening) milking times milk yield was comparatively higher ( $P<0.05$ ) on machine milking ( $8.75^a \pm 0.03$ ,  $0.79^c \pm 0.01$ ,  $8.20^b \pm 0.03$ , respectively) than manual milking ( $6.50^c \pm 0.04$ ,  $0.69^f \pm 0.02$ ,  $6.03^d \pm 0.03$ ).

#### 3.3 Milk composition:

The results regarding fat and SNF contents (%) are presented in table 06. The manual method at twice milking frequency showed higher fat% ( $4.14 \pm 0.14$ ) than (manual method at thrice milking time) ( $3.89 \pm 0.07$ ). However, the fat contents was non-significant ( $P>0.05$ ) among in all treatment groups. The results of SNF between all treatments were similar ( $P>0.05$ ).

#### 3.4 Cost of milk production

Cost of production per liter milk yield is presented in table 08. The cost of production was higher on both manual milking patterns while it was lower on machine milking frequencies.

#### 3.5 Behavior

The behavior (stepping and kicking) of Holstein Friesian cows during milking is given in table 08. The stepping behavior was observed higher on thrice manual milking method while trend was lower when animal were milked thrice by machine. However kicking behavior was higher in case of manual three time milking and it was lower in case of animals milked two times by machine.

**Table 3:** Dry Matter Intake (Mean $\pm$ S.E) of Holstein Friesian cows on different milking methods and milking frequencies at GDF Quetta

Group	Method	Frequencies	DMI (kg/d)
A	Manual	Twice	16.74 $\pm$ 0.55
B	Manual	Thrice	16.63 $\pm$ 0.53
C	Machine	Twice	16.74 $\pm$ 0.51
D	Machine	Thrice	16.70 $\pm$ 0.57
Level of Significance			N.S

N.S= Non significant ( $P>0.05$ )

GDF= Government Dairy Farm

**Table 4:** Influence of milking methods on milk yield (Mean $\pm$ S.E) at two time of milking frequencies in Holstein Friesian cows at GDF, Quetta

Group	Methods	Milking Time	Milk Yield (L/d)
A	Manual	Morning	7.67 <sup>d</sup> $\pm$ 0.03
		Evening	7.83 <sup>c</sup> $\pm$ 0.03
C	Machine	Morning	8.52 <sup>b</sup> $\pm$ 0.06
		Evening	8.86 <sup>a</sup> $\pm$ 0.70
Level of Significance			$P<0.05$

Means with different superscript within same column are significantly different ( $P<0.05$ )

**Table 5:** Influence of milking methods on milk yield (Mean $\pm$ S.E) at three time milking frequencies in Holstein Friesian cows at GDF, Quetta

Group	Methods	Milking Time	Milk Yield (L/d)
B	Manual	Morning	7.43 <sup>d</sup> $\pm$ 0.03
		Noon	0.69 <sup>f</sup> $\pm$ 0.02
		Evening	7.60 <sup>e</sup> $\pm$ 0.04
D	Machine	Morning	8.20 <sup>b</sup> $\pm$ 0.03
		Noon	0.79 <sup>c</sup> $\pm$ 0.01
		Evening	8.75 <sup>a</sup> $\pm$ 0.03
Level of Significance			$P<0.05$

Means with different superscript within same column are significantly different ( $P<0.05$ )

**Table 6:** Influence of milking methods and milking frequency on milk composition (Fat and SNF contents) in Holstein Friesian cows at GDF, Quetta

Group	Milking method	Frequency	Fat (%)	SNF (%)
A	Manual	Twice	4.14 $\pm$ 0.14	9.72 $\pm$ 0.17
B		Thrice	3.89 $\pm$ 0.07	9.70 $\pm$ 0.05
C	Machine	Twice	3.99 $\pm$ 0.06	9.46 $\pm$ 0.11
D		Thrice	3.95 $\pm$ 0.17	9.46 $\pm$ 0.08
Level of Significance			N.S	N.S

N.S= Non significant ( $P>0.05$ )

**Table 7:** Cost of production per liter milk yield in different groups on manual and machine milking at GDF, Quetta

Group	Milk yield /d (Rs)	Feed Cost /d (Rs)	Cost of production / L(Rs)
A	62.00	1500	24.19
B	62.88	1500	23.85
C	69.52	1500	21.58
D	71.00	1500	21.13

\*Cost of feed per animal is Rs. 375/d

\*\*GDF milk rate is Rs. 60/L

**Table 8:** The behavior (Stepping and kicking) of Holstein Friesian cows during milking at on different milking methods at GDF, Quetta

Groups	Behavior	
	Stepping (Stand/mangers/ utensil)	Kicking (Milk man/ utensil)
A	85%	50%
B	95%	55%
C	85%	43%
D	78%	46%

### 4. Discussion

#### 4.1 Dry matter intake (DMI)

Dry matter intake in animals is important as it relates to maintenance and production. Many factors affect dry matter intake, the age, size, growth, production, feed ingredients, season and management etc are the major contributors among them [11, 12]. In our study, apparently, the higher DMI was

observed in group A (16.74 kg/d) whilst comparatively lower in group B (16.63 kg/d). However, statistically, the DMI was not significantly different ( $P > 0.05$ ) among all groups (table 03). The similar dry matter intake may be due to the fact that all feed ingredients were thoroughly mixed treatment groups having approximately similar age, weight and stage of lactation. Our findings are in agreement with the work done by <sup>[11, 12]</sup>.

#### 4.2 Milk yield

The milk yield in animals varies with genetic, feeding, health and management differences. Our study on lactating Holstein Friesian cows mainly focused on knowing the effects of milking method and frequency of milking on milk production. The results of the milk yield presented in tables 04 and 05. It reveals that the milk yield is significantly different ( $P < 0.05$ ) when compared both milking methods at different milking frequencies. Milk yield obtained maximum ( $P < 0.05$ ) on machine milking method at both twice and thrice milking frequencies. These results are in line with the findings of <sup>[11]</sup> similar finding were also reported by <sup>[13]</sup>. Our findings are also similar to the findings of <sup>[14, 15]</sup>. They reported similar effect of manual and machine milking methods on milk yield. Whereas the findings of <sup>[16, 17]</sup> are in disagreement with our findings that may be due to factors i.e., breed, environmental influence, management and milking frequency and feed.

#### 4.3 Milk composition

Milk composition differs with breed, species, nutritional management, lactation and lactation stage <sup>[18]</sup>. The fat and SNF contents (%) on the machine and manual milking methods at twice and thrice milking frequencies are given in table 06. No significant differences recorded in fat and SNF contents between both milking methods at twice and thrice milking frequencies. The fat contents were comparatively higher in cows milked twice compared to those milked thrice times per day however, this difference was similar statistically. The results of the study are in line with <sup>[11]</sup> who reported maximum milk fat contents in cows milked twice compared to those milked three times per day. Similarly studies conducted by <sup>[15, 19, 20, 21]</sup>, reported similar findings. Conversely, <sup>[22]</sup> reported that frequency did not affect the yield of fat contents. This may be due to the difference in breed, environment practices and feed.

Likewise, the SNF contents remained similar ( $P > 0.05$ ) on both machine and manual milking methods at twice and thrice milking frequencies. Finding of <sup>[11, 23]</sup> were in line with our result. Contrary to our study, <sup>[24]</sup> reported that the machine milking method may yield milk up to 38% as compared to hand milking.

#### 4.4 Cost of milk production

The results regarding the cost of production/liter (CoP/L) milk yield are given in Table-7. It revealed that the CoP/L milk yield was higher in cows subjected to twice milking as compared to the cows subjected to thrice milking. Similar to our findings, <sup>[25]</sup> reported that thrice time milking lessened 28 percent cost as compared to twice time milking. Likewise <sup>[26]</sup> who reported that higher milking frequency increase milk production and reduces cost. <sup>[27]</sup> reported that milking frequency twice time is better than thrice time as the feed and labor charges go on the increase as compared to twice time milking frequency.

#### 4.5 Health/number of mastitis cases

In our study, the health related matters particularly the numbers of mastitis cases were not found in experimental cows. It may be due to the good management practices at Quetta Dairy Farm where equipment and hands were washed with antiseptics solution before and after milking therefore the chance of mastitis cases remained dormant.

In contrast to our findings, <sup>[11]</sup> found mastitis 25% in treated animals. Similarly <sup>[28]</sup> reported that manual milking methods increased the mastitis cases as compared to machine milking methods. <sup>[8]</sup> found that the influence of machine milking transmitted the pathogen of mastitis due to irregular fluctuations.

#### 4.6 Behavior

The results regarding cows' behavior are given in table 08 that varied with milking methods and their respective frequencies. The kicking/stepping habits were recorded more pronounced in hand milking as compared to machine milking. In milking frequencies, the twice milking frequency was also influenced in developing stepping, kicking habits as compared to thrice milking frequency. <sup>[29]</sup> findings are in line with our study who reported that manual milking developed the kicking and findings of <sup>[30]</sup> are also in line with our study who reported that developed the kicking and stepping behavior during milking <sup>[31]</sup> were deduced in their study that in machine milking heart rate increases which ultimately put cows in stress and let them to develop abnormal activities.

#### 5. Conclusions

It was concluded that machine milking can be practiced in Holstein Friesian cattle and maximum production in a short time can be produced by thrice a day milking in high yield animals.

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