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Full Length Research Paper

Diet intake and milk production of Holstein-Friesian cows under the influence of different water and feeding frequencies

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This study was performed at the Danial dairy farm, Karachi. A total of 150 Holstein-Friesen cows under 3rd lactation were selected from 300 cows and divided into 5 groups. The findings of our study indicated that the daily water intake was found significantly maximum (47.00±1.45) in group-B and minimum (43.33±0.88) in group-D. Statistically significant differences were seen in group D with the rest of the groups. The maximum daily feed intake (19.66±2.40) was recorded in group-A, while the minimum daily feed intake (15.00±0.57) was recorded in group-B. There was a significant difference in the daily feed intake for group E with groups A and B. The maximum weekly milk production (40.00±1.45 kg) was recorded in group-A, while the minimum weekly milk production (34.00±0.88 kg) was recorded in group-B. However, there were significant differences in the weekly milk production among groups A and B. In conclusion, Holstein-Friesian cows produced significantly higher weekly milk production under group A (control), which offered 24 h of water and was fed ad-libitum compared to all other groups.

Key words: Diet, milk, feed, water.

INTRODUCTION

The water requirement per unit of body mass of the high-producing dairy cow is greater than that of any other land-based mammal. It may be because cow produces a large amount of milk, which is 87% of water (King and Stockdale, 2014; Alamer, 2015). Furthermore, the total body water content of adult dairy cattle ranges between 56 and 81% of body weight (Aganga, 2012). Cows in early lactation have more live body weight as water compared to cows in later lactation (69.0 vs. 62.4%); body water content of late pregnant dry cows is estimated as 65% of total body weight (Andrew et al., 2014). About two-thirds of water in the body is in the intracellular compartment. The remaining one-third of water is in the extracellular spaces around cells and connective tissues, in blood, and as transcellular water or water in the digestive tract. The water in the digestive tract accounts for 15 to 35% of body weight (Devendra, 2014; Senn et al., 2016a). Factors affecting water consumption may include frequency and periodicity of watering, temperature of the water, and social and behavioral interactions of animals. Water requirement of dairy cattle is mainly met from drinking resources, which is found in or on feed, and a small amount from metabolic oxidation (metabolic water) (Meyer et al., 2014). The dry matter content of the diet is also an important factor affecting total water consumption (Dahlborn, 2011). Alamer and Al-Hozab (2004) found relatively small differences in drinking water intake; however, when dietary DM content declined from 50 to 30% (ration moisture content increased from 50 to 70%), the drinking water intake declined by 42%. Stockdale et al. (2011), in estimating the drinking water intake of lactating dairy cows on pasture, found that only 38% of the total water consumption was used as free drinking water (Senn et al., 2016b; Little et al., 2012). There is a direct relationship between DMI and water intake in cattle. If water intake is sub-normal, feed DM intake typically will decrease (Dahlborn, 2011). The efficient utilization of

Table 1. Experimental design.

Groups	A (Control)	B	C	D	E
Feed	24 h Feed (*Ad-libitum*)	2 times Feed/Day at Morning 6 am and Evening 6 pm	3 times Feed/Day at Morning 6 am, Noon 2 pm and Night 10 pm	24 h Feed (*Ad-libitum*)	24 h Feed (*Ad-libitum*)
Water	24 h Water (*Ad-libitum*)	24 h Water (*Ad-libitum*)	24 h Water (*Ad-libitum*)	2 times Water/Day at Morning 6 am and Evening 6 pm	3 times Water/Day at Morning 6 am. Noon 2 pm and Evening 10 pm

feed by the animals could be attributed to the breed, physiological status of the animals and the quality of the feed offered.

The study hypothesize that water consumption of animals also considerably influences the diet intake and overall milk production. Thus, the current study was planned in order to observe the possible impact of water consumption on milk production and the daily diet intake in Holstein-Friesian cows.

MATERIALS AND METHODS

The study was done at the Danial Dairy farm, Karachi. Out of a total of 300 Holstein-Friesen (n=300) Cows, Fifteen (n=150) (3rd Lactation) were selected randomly and distributed into 5 groups. The study was performed as per following the experimental design, as shown in Table 1.

All Groups (A, B, C, D and E) contained the same composition of feed and water. A similar type of housing and bedding system was provided to all the experimental cows. The following parameters were recorded:

Daily water intake (L)

Fresh water was provided to the animals daily. Refuse water was collected and measured in the beaker, and maintained their records on daily basis. The refuse water was deducted from the offered water through the following formula:

Water intake (L/animal/day) = Total water offered (L) – Total water refused (L)

Daily feed intake (kg)

Feed was provided to the animals on a daily basis. The feed, which refused to be deducted from the feed, was offered to each group on a daily basis. Finally, the consumed feed was recorded by using the below formula, as follows:

Feed intake (Kg/animal/day) = Total feed offered – Total feed refused

Weekly milk production (liters)

Weekly milk production of each animal from all groups was noted on spread sheet and average values were presented in the result section.

Statistical analysis

The collected data was tabulated and statistically analyzed by the statistical software, Student Edition of Statistics (SXW) version 8.1, and presented as Mean ± SE. Differences were considered significant at ($P < 0.05$).

RESULTS AND DISCUSSION

The research was done at the Danial dairy farm, Karachi, in which a total of Fifteen (n=150) (3rd Lactation) cows were selected from a total of 300 Holstein-Friesen (n=300) cows. Cows were distributed into 5 groups and the influence of different water and feed frequencies on the diet intake and milk production was assessed. The results with regard to different parameters of study are given in the respective sections.

Daily water intake (L)

The daily water intake (liters) of Holstein-Friesian is shown in Table 2. The data showed that the maximum daily water intake (47.00±1.15 liters) was recorded in group-B and the minimum daily water intake (43.33±0.88 liters) was recorded in group-D. However, there was a significant difference in the daily water intake for group D with the rest of the groups, while there was a non-significant difference in the daily water intake among groups A, B, C and E. The findings of the present study were supported by Mengistu et al. (2007), who stated that the calculated daily water intake of every day watering

Table 2. Effect of water and feeding frequencies on the daily water intake (Liters), daily feed intake (Kg) and daily milk production (kg).

Parameter	Group-A	Group-B	Group-C	Group-D	Group-E
Daily water intake (liters)	45.66±1.45^{b}	47.00±1.15^{a}	46.5±0.57^{ab}	43.33±0.88^{c}	44.00±0.57^{b}
Daily feed intake (kg)	19.66±2.40^{b}	15.00±0.57^{b}	16.00±0.33^{ab}	17.00±0.88^{ab}	18.50±0.88^{a}
Daily milk production (kg)	20.00±1.45^{a}	17.00±0.88^{c}	18.00±1.73^{b}	18.50±0.57^{b}	19.00±0.88^{ab}

^{abcd} = Values are significantly different ($P<0.05$) from each other.

group was significantly higher compared with the every 2nd, 3rd and 4th day watering groups. Adogla-Bessa and Aganga (2000) also reported a lower free water intake of Tswana goats deprived of water for 48 and 72 h, as compared to goats watered after every 24 h.

Daily feed intake (kg)

The daily feed intake (kg) of Holstein-Friesian is shown in Table 2. The data showed that the maximum daily feed intake (19.66±2.40 kg) was recorded in group-A, while the minimum daily feed intake (15.00±0.57 kg) was recorded in group-B. There were significant differences in the daily feed intake for group E with groups A and B. However, there was a non-significant difference in the daily feed intake between groups (A and B), as well as groups (C, D and E), correspondingly. Findings of the present study were supported by Silanikove (1985), who reported that reduction in water intake causes reduction in dry matter intake. Silanikove et al. (1997) reported that free water intake had a positive effect on dry matter intake. Little et al. (1976) reported that 40% drop of water intake was connected to 16% decrease in dry matter intake. These studies are also in line of the current study. Further, in support of the present study, Sing and Stockdale (2002) reported that animals watered once in a day, had lower feed intake. Alamer and Al-hozab (2004) reported a decline in feed intake as a result of water restriction, which was highest in summer (96.5%), followed by spring (75%) and winter (62%) in Awassi and Najdi sheep in Saudi Arabia. Alamer and Al-Hozab (2004) reported a fall in dry matter intake with almost a similar rate in 25 and 50% watering restriction in goats. The results of the present study confirms the findings of the above cited studies; the dry matter intake and green fodder intake increased significantly with increasing water intake.

Daily milk production (kg)

The daily milk production (kg) of Holstein Friesian is shown in Table-2. The data showed that the maximum weekly milk production (20.00±1.45 kg) was recorded in group-A, while the minimum weekly milk production (17.00±0.88 kg) was recorded in group-B. However, there were significant differences in the weekly milk production amongst group A and B, while non-significant between groups C and D, as well as A and E, correspondingly. The findings of the present study were supported by Meyer et al. (2004), who reported that milk production increased with the addition of water intake. Khan et al. (2012) reported that reduced or decreased watering had a negative effect on milk production, whereas free access to drinking water had a positive effect on milk yield. The findings of present study were also supported by Aganga et al. (2016), who reported that water deprivation for 72 h reduces milk production by 50% in lactating sheep and goats; moreover, water deprivation for 72 h causes an increase in the viscosity of milk, as well as protein, fat, lactose, etc. Little et al. (1984) reported that milk production reduced by 28% on the third day of water deprivation in the dairy cow; however, milk composition was not altered much. Hilali et al. (2015) reported that water deprivation for 48 h caused reduction in milk production by 28%. Senn et al. (2016a) reported that water deprivation decreased milk yield by about 30%. Thokal et al. (2004) agreed with the present study, who reported that the average milk production decreased by 16% due to restriction of watering frequency from free access to twice-a-day in cattle, and there was no significant effect of watering frequency on fat, solids not fat and total solids contents of milk. King and Stockdale (2014) disagreed with the present study, who reported that there was no significant reduction of average milk production (average 12.6 kg/cow/day) for a cow on watering free and twice a day; however, milk production decreased for a cow on watering once a day.

Conclusion

The present study concludes that the Holstein-Friesian cows produce significantly higher milk production on ad-libitum feed and water supply.

Authors' contribution

Qurban Ali Memon: performed research, collected data and entered the data in SPSS for analysis.
Asad Ali Khaskheli: conceived the idea, wrote abstract, introduction, methodology, results, discussion, conclusion, references, and also provided technical inputs in the research.

Turab Ali Kaurejo: contributed in overall management of the article
Maqsood Ahmed Kumbhar: Did SPSS analysis

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Conflict of interest

The authors declare no conflict of interest.

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