World Journal of Dairy & Food Sciences 7 (2): 146-149, 2012
ISSN 1817-308X

DOI: 10.5829/idosi.wjdfs.2012.7.2.64136

Effect of Lactation Stage, Pregnancy, Parity and Age on Yield and Major Components of Raw Milk in Bred Cross Holstein Friesian Cows

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Abstract: A study was carried out on lactating cross bred Holstein Friesian cows with the objectives of evaluating the effect of stage of lactation, pregnancy, parity and age, on yield, major components (fat, protein, solid not fat, lactose and ash) and pH of milk. Milk samples were directly collected from the teat and immediately analysed using milk analyser machine. The result showed that lactation stage and pregnancy significantly ($P<0.05$) affected the milk yield whereas milk yield did not show significant variation in different age and parity groups. The highest yield was recorded in mid stage and lowest in late stage of lactation. The yield was higher in non-pregnant than pregnant cows. The fat content of the milk was significantly higher ($P<0.05$) in early and late than mid stage of lactation. However, fat content was not significantly varying with age, pregnancy and parity. The solid not fat (SNF) and protein contents of the milk were significantly different in pregnancy and age but it was not significantly affected by stage of lactation and parity. The lactose content of the milk was affected significantly ($P<0.05$) by pregnancy only. But the ash content and the pH of the milk were not affected significantly by stages of lactation, pregnancy, age and parity of the cows. This study indicated that different factors affect the milk yield and major milk components.

Key words: Cows · Holstein Friesian · Lactation Stage · Pregnancy · Parity · Age

INTRODUCTION

Milk is a fluid secreted by the mammary glands of mammals to feed their young. It is a good source of nutrients and hence important for growth, repairs and provides energy. The nutritive value varies with its composition. The composition of cows' milk is also of the greatest importance for the dairy industry. Since, its processability is highly influenced by composition. Knowing the composition of milk also helps to assess adulteration and the quality of the milk for consumers and milk processing industries. The price of milk and consumers interest varies with milk components, which may directly affect the farm income. Moreover, milk is an important diet for the majority of rural and urban population of Ethiopia. About 3.2 billion litres of milk is produced daily. Despite small contribution of camel and goats, almost 97 % of milk is coming from cows. In addition to its nutritional value, it is also a means of generating income [1]. In the livestock development policy of the country, to increase the yield, improvement of the genetic potential of the indigenous zebu has been conducted through breeding with high-grade exotics. Hence, it is quite common to see a cross Holstein Friesian cows with better adaptability and yield. Different factors may influence the composition of milk [2]. Information about variation of milk composition in relation to parity, lactation stage and pregnancy status in crossbred cattle is scant. The present study was designed to assess the effect of these factors on yield, major composition and pH of milk of cross Holstein Friesian cows.

MATERIALS AND METHODS

Study Area: The study was conducted at University of Gondar, Faculty of Veterinary Medicine dairy farm, North-western Ethiopia, from November 2010 to May 2011. The farm is located in the university compound which is about 750km away from the capital (Addis Ababa), at latitude, longitude and altitude of 12.3-13.8 North, 35.3-35.7° East and 2200 meter above sea level, respectively. The rainfall varies from 880 to 1772 mm. The annual mean minimum and maximum temperature of the area vary between 12.3-17.7 and 22-30°C, respectively.

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The area has two seasons, the wet season from June to September in which the area gets its majority of rainfall and the dry season from October to May which receives small and erratic rainfall [3].

Study Animals: In the study, a total of 30 cross breed Holstein-Friesian lactating cows which are managed under semi-intensive husbandry systems were included. The farm was established in May, 2009 with about 70 cows. The cows were provided with the hay in the morning and evening and also allowed for field grazing during the day time. In addition, a by-product of brewery factory was also given every day. All cows were maintained in separate barn under spacious, well constructed house especially at night. They have *ad libitum* water supply.

Sampling and Study Design: The study animals were classified according to lactation stage. Those cows between 7 to 105 days of delivery were classified as early, between 106 to 210 days as mid and those in between 211 to 315 days under late stage of lactation [4]. Milk sampling was carried out in the morning and the daily milk yield was also recorded. The information about the age and parity of cows were obtained from the records available in the farm. Cows up to four years were classified as young whereas those greater than four years as adult. Pregnancy was confirmed by rectal examination.

Milk samples were obtained from individual animals by hand milking. After collection, samples were taken to laboratory of Faculty of Veterinary Medicine, Gondar University, for analysis. Analysis was done immediately using Ultramilker UL20A milk analyzer machine and done according to the manufacturer's instructions. The pH was measured by a digital pH-meter as described by Aggad *et al.* [5].

Statistical Analysis: The raw data were entered into Microsoft Excel work sheet and descriptive statistics were calculated in it. For the variables which require multistage sampling (pregnancy and lactation stage) paired t-test and repeated measure analysis of variance were used. For the variables that didn't require multistage sampling (age and parity) independent t-test was used for comparison. All statistical analyses were done using the SPSS version 17 software package. Probability (*P*) value less than 0.05 was used to determine the level of significance.

RESULTS

Lactation Stage: Lactation stage significantly ($P<0.05$) affected the milk yield. The highest yield was recorded in mid stage of lactation (7.17 L/d) followed by the early period (6.81 L/d) and lastly in late of lactation (5.48 L/d). The fat content of the milk was statistically different ($P<0.05$) in three stages of lactation. It was higher in early and late stages than mid stage of lactation. But no difference was observed in SNF, protein, lactose, ash and pH of the milk (Table 1).

Table 1: Mean milk yield and the major components of milk in early, mid and late lactation stages

Components	Early lactation	Mid lactation	Late lactation
Milk yield, L/d	6.81±1.45	7.17±0.05[a]	5.48±0.05
SNF, %	8.77±1.39	8.43±0.21	8.12±1.07
Fat, %	4.46±1.44	3.70±0.89	4.46±1.44
Total protein, %	3.55±1.43	3.17±0.15	3.33±0.16
Density	27.42±3.60	26.40±1.92	26.51±2.81
Lactose %	4.80±0.56	4.68±0.41	4.72±0.50
Ash, %	0.64±0.07	0.62±0.02	0.64±0.02
pH	6.62±0.17	6.55±0.20	6.73±0.16

[a]Mean ± standard deviation (SD)

Table 1: The mean in milk yield and the major components in premiparous and multiparous cross Holstein Friesian cows

	Parity	
Components	Primiparous	Multiparous
Milk yield, L/d	6.43±1.39	5.89±2.37
SNF, %	8.38±0.31	8.54±0.56
Fat, %	3.61±0.75	3.30±1.78
Total protein, %	3.23±0.14	3.30±0.27
Density	26.90±1.63	28.44±4.03
Lactose %	4.71±0.30	4.86±0.54
Ash, %	0.63±0.03	0.64±0.03
pH	6.58±0.20	6.65±0.17

Mean ± standard deviation (SD)

Table 2: The mean in milk yield and the major components in non-pregnant and pregnant cows

	Pregnancy	
Components	Non-pregnant	Pregnant
Milk yield, L/d	6.69±1.49	5.52±1.33
SNF, %	8.61±0.81	8.91±0.69
Fat, %	3.41±1.62	3.47±1.56
Total protein, %	3.34±0.74	3.50±0.32
Density	27.73±3.21	28.50±3.01
Lactose %	4.85±0.44	5.03±0.57
Ash, %	0.64±0.04	0.66±0.06
pH	6.60±0.21	6.63±0.16

Mean ± standard deviation (SD)

Table 3: The mean in milk yield and the major components in young and adult cows

	Age	
Particulars	Young	Adult
Milk yield, L/d	6.82±1.97	6.49±2.14
SNF, %	8.62±0.55	8.77±0.52
Fat, %	3.91±1.35	4.16±1.17
Total protein, %	3.28±0.22	3.37±0.33
Density	28.59±2.93	28.24±2.57
Lactose %	4.86±0.43	4.97±0.53
Ash, %	0.64±0.04	0.65±0.04
pH	6.55±0.21	6.63±0.21

Mean ± standard deviation (SD)

Parity: Cows were divided into primiparous and multiparous based on the number of calving, it was found that average milk yield was 6.43 and 5.89 L/d in primiparous and multiparous cows, respectively. However, it was not statistically significant. The major components (fat, SNF, protein and lactose) and pH of the milk were also not differing in primiparous and multiparous cows (Table 2).

Pregnancy: The mean milk yields per day in non-pregnant and pregnant cows were 6.69 and 5.52 litres, respectively and the variation was statistically significant ($P< 0.05$). The protein, SNF and lactose components of the milk were significantly lower ($P< 0.05$) in non-pregnant than pregnant cows. However, significant difference was not observed in fat composition and pH of the milk (Table 2).

Age: The mean milk yield was 6.82 and 6.49 L/d in young and adult cows, respectively. However, there was no statistically significant difference between the two age groups. The protein and SNF components of the milk were significantly lower ($P<0.05$) in young than adult cows. However, significant difference was not observed in fat, lactose and pH of the milk between age groups (Table 3).

DISCUSSION

A study on milk yield and milk composition is of most important to evaluate the milk production ability of milking animals. The present study described the effect of stages of lactation, age parity and pregnancy on milk yield and composition in dairy cows of Gondar University. The mean milk yield (5.48 to 7.17 L/d) in the farm was found to be much lower than that of pure Holstein Friesian cows (8.8 kg), [6]. But, it was better than the milk yield of local zebu cows (0.5-2 L/d) [7]. The occurrence of the peak milk yield at the mid of lactation in this study agrees with the report of Mech *et al.* [8] in buffaloes which stated that milk yield increased up to 90 days and remain high for a while and then declines in late stage of lactation. Milk yield was also affected significantly by pregnancy. This result agrees with the report of Akers [9] who stated that pregnancy has a negative effect on milk yield. A decline in milk yield with pregnancy in dairy buffaloes was also reported by Khan *et al.* [10]. This may be due to hormonal changes, causing regression of the mammary gland and nutrient requirements of the foetus, reducing available nutrients for milk production [11]. Milk yield did not show significant variation in different age and parity groups. This may be due to the fact that the farm is established only two years ago that cows are fairly young and calving was not much.

Fat content was lowest in mid lactation and significantly increased in early and late lactation stages. The influence of lactation stage on goat milk fat was also reported by Bhosale *et al.* [12]. The finding in this study was inline with Stoop *et al.* [13]. However, the finding disagrees with the report of Bohmanova *et al.* [14] who reported that fat content of the milk was lower especially in late stage of lactation. This may be due to differences in breed and other confounding factors between two studies. Unlike stage of lactation, fat content was not significantly varying between different age, pregnancy and parity groups.

The solid not fat (SNF) and protein contents of the milk were significantly different in pregnancy and age. Higher protein content of pregnant animal milk may be related with the general increments in anabolism of major nutrients. Equivalent to this finding were also observed by Casoli *et al*. [15] and Dell'Aquila *et al*. [16] in sheep. However, SNF and protein contents of milk were not significantly affected by stage of lactation and parity.

In this study, lactose was not significantly affected throughout the lactation stage. Lactose is the main determinant of milk volume. A close relationship between lactose synthesis and the amount of water drawn into milk makes lactose a stable milk component [17]. The lactose content of the milk was affected significantly by pregnancy only; other factors didn't affect its composition in milk.

Ash content was found to be the least variable of milk component unlike that reported in Fulani cows, West African Dwarf (WAD) does and WAD ewes in Nigeria [18]. pH did not vary significantly throughout the lactation period.

In general, many factors besides nutrition and management can influence milk yield and composition. This is an important point to remember when evaluating the milk quality and in the improvement of milk yield and composition.

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