

Research Article**SEASONAL VARIATION IN MILK YIELD, FAT AND SNF CONTENT OF MURRAH CROSSBRED BUFFALO IN MID-WESTERN TERAI REGION OF NEPAL****N. Bhattarai**

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ABSTRACT

A research was done during July 2016 to June 2017 for a period of one year at Baijanath Rural Municipality, Banke district of mid-western terai region of Nepal to analyze the seasonal variation in average daily milk yield (DMY), standard 305 days milk yield (SMY), fat percent and solid-not-fat (SNF) percent in the milk of crossbred Murrah buffaloes. A total of 1086 milk sample was purposively collected from 235 lactating crossbred Murrah buffaloes of early (first and second) parity and were analyzed for major quality traits of milk covering four seasons- spring (February to April), summer (May to July), autumn (August to October), and winter (November to January). Results revealed that season had significant influence on DMY ($p < 0.05$), SMY ($p < 0.01$), fat ($p < 0.01$) and SNF ($p < 0.01$) content of crossbred Murrah buffaloes. Accordingly, highest DMY and SMY was recorded for the buffaloes calved in spring season with highest fat and SNF content during summer and spring season, respectively. Thus, results of this study reflected a scientific fact about wider variation in milk yield, fat and SNF contents in Murrah buffaloes with the significant effect of season. This information could be useful in recognizing the importance of synchronizing calving dates during spring season for higher production and productivity in order to maintain the quality aspects of milk, such as fat and SNF content. Further investigation is, however, required regarding genetic parameters determination of these traits covering wider population in the region.

Key words: Murrah, seasonal variation, Fat, SNF, genetic parameters**INTRODUCTION**

Agriculture sector contribute about 33% of total GDP in Nepal. It provides job opportunities to about 65 % of the economically active population (MOALD, 2019). Livestock sub-sector is important to contribute to the agricultural output that shares about 11 percent to the national GDP, and approximately 27 percent to AGDP (MOALD, 2019).

Dairy is a vital part of the global food system and it plays a key role in sustainability of rural areas in particular. In Nepal, dairy sector alone contributes about 9 percent to total GDP (MOALD, 2018) and buffalo alone contributes about two third to total milk production and more than half to the total meat production in the country. The lactation milk yield is one of the most significant dairy parameters. Factors influencing production performance could also affect to the buffalo lactation including lengths (Chaudhary, 1992). The normal scenario of lactation is such that at first, lowest output is achieved per lactation. As the age passes, milk production increases and it hit the limit upon reaching to the 3rd and 4th lactations, and then it starts again to decrease. Peak yield has good correlation with milk production ($r=0.448$). Result which demonstrate peak yield could be reliable in predicting livestock productivity. Milch animal are supposed to be economical if she has short dry period and low colostrum period (Poudel, 2017). Maintaining a higher milk production is always a very important objective for the dairy farmer. However, optimum milk yield and composition is influenced by several factors including, but not limited to, feeding, health status of the breed, and genetic variation within the breed, parity, age and length of dry period in the preceding lactation (Hasanpur et al., 2019; Afzal et al., 2007; Bajwa, et al., 2004).

Parameter estimates of the lactation are also useful for assessing the health and nutritional status of animals as undernourished animals have a lower proportion of milk components (Shrestha et al., 2005; Shrestha et al., 1994; Egbowon, 2004). The persistence of lactation is also important in assessing the production capacity of Animal. Animal persistence is a trait that is correlated with yield decline, once the animal hits peak milk yield (Appuhamy, 2007), exposing a specific animal's capacity for growth. Nonetheless, lactation period, animal parity, and calving season are some other significant factors in cattle (Shah et al., 2016), buffalo and goat (Akingbade, 2003) that could well influence to the milk yield and its composition. Considering the importance of buffalo management in Nepalese rural livestock sector, a scientific research was done in Murrah crossbred buffaloes to analyze the effect of seasonal variation on milk production including composition and quality parameters.

MATERIAL AND METHODS

This study was done at Baijanath Rural Municipality, Banke district of mid-western terai region of Nepal during

July, 2016 to June, 2017 for a period of one year with a special involvement of Lalpur Milk Producers Cooperative Limited. Milk production records of randomly selected 235 buffaloes of early (first and second) parities reared by the member farmers of Lalpur Cooperative were recorded for a year. Accordingly, a total of 1086 milk samples collected purposively for four seasons of the year were analyzed covering fat and SNF contents. The four seasons included spring (February to April), summer (May to July), autumn (August to October), and winter (November to January). To study the effect of season on daily milk yield (DMY), standard 305 days milk yield (SMY), fat and solid-not-fat (SNF) content, data were analyzed using fixed effect model (presented in equation- I) of Mixed Model Least Square Maximum Likelihood (PC)- 2 computer program developed by Harvey (1990) was used.

$$Y_{ij} = \mu + a_i + e_{ij} \dots\dots\dots 1$$

Where,

μ = Overall mean

a_i = effect of i^{th} season

e_{ij} = random (residual) element assumed to be randomly and independently distributed.

RESULTS AND DISCUSSION

Average daily milk yield

The grand mean of the average daily milk yield was 4.65 kg with a wider range suggesting wider variation in milk yield. Mean daily milk yield was higher for spring, but it was statistically similar to the daily milk yield of summer and winter (Table 1). The mean daily milk yield of Autumn and Winter was lowest, but they were statistically similar ($p>0.05$).

The effect of season on milk yield could have been confounded by breed, stage of lactation and environment (Hasanpur et al., 2019). Level of milk yield increased during spring season and was found to be decreased in autumn season with constant yield in the summer and winter season. This may due to the sufficient availability of green fodder and grass in the rainy and spring seasons due to the rainfall. Likewise the low level of mean daily milk yield during Autumn and Winter could have been related to poor availability of grasses/fodder, and seasonal effect (Klipple, 1964; Regmi & Devkota (2009). A significant increase in milk production ($p<0.05$) in the buffaloes calved in spring season may also explain the retention of water in the body and the reduced dissipation of energy through the oxidative respiratory cycle, which leaves acetate to be channeled into fat synthesis pathways, improving production without causing stress in these animals (Clark, 1977).

Standard 305 days milk yield

Standard 305 days milk yield divulge significant result ($p<0.01$) with grand mean of 1655.10 ± 26.50 kg with a huge variation in the performance (Table 1). In the case of standard 305 days milk yield as well, it was significantly highest ($p<0.001$) for spring followed by summer season, but summer season milk yield was statistically similar ($p>0.05$) to that of winter season. Autumn season milk yield was statistically lowest ($p<0.05$) to the total milk yield of rest of the seasons (Table 1). The findings of this study were in concordance with the values reported by ABD (2013) for the crossbred Murrah buffaloes in the hilly regions of western Nepal.

This variation is described by Klipple (1964) by explaining the fact related to the unavailability of fodder/forages and grazing grass/herbs/shrubs in the autumn season. Similar trend of DMY and SMY as in this study was also reported by Sigdel et al (2015) and Thapa (2013).

Table 1. Seasonal influence on daily milk yield (DMY) and standard 305 days milk yield (SMY) of buffaloes in mid-western Terai region, Nepal

Items	No. of calving	Average daily milk yield (kg.)	305 days milk yield (kg)
Grand Mean	235	4.65 \pm 0.22	1655.10 \pm 26.50
Range	235	1.20 – 12.40	375 – 3850
Seasons			
Spring (February-April)	7	5.62 \pm 0.73 ^a	1725.64 \pm 86.72 ^a
Summer (May-July)	62	4.82 \pm 0.29 ^a	1645.32 \pm 54.28 ^b
Autumn (August-October)	132	3.85 \pm 0.17 ^b	1550.25 \pm 32.36 ^c
Winter (November-January)	34	4.50 \pm 0.54 ^{ab}	1620.68 \pm 50.35 ^b
Level of Significance		* ($p<0.05$)	** ($p<0.01$)
CV %		18.5%	15.8%

Note: *-Significant at $p<0.05$; **-Significant at $p<0.001$; CV- Coefficient of Variation.

Distribution of fat and SNF content

The fat and SNF contents of 1086 milk samples recorded in this study are graphically presented in histogram (Figure 1). Results clearly revealed that the distribution of fat content of these milk samples were perfectly symmetric and unimodal, without any outliers, with the average fat content of buffalo milk of 5.13 percent that ranged from 2.0 to 8.31% (Figure 1; Table 2). On the other hand, distribution of SNF content for the same samples roughly appeared to be symmetrical where the value ranged from 4.47 to 9.50 percent (Figure 1, Table 2). Results also indicated that about 71.2 percent buffaloes produced more than 5 percent fat and 46.2 percent buffaloes produced more than 8 percent SNF. Similar results were also reported by ABD (2013) suggesting a wider variation in milk fat and SNF content of buffaloes in Nepal.

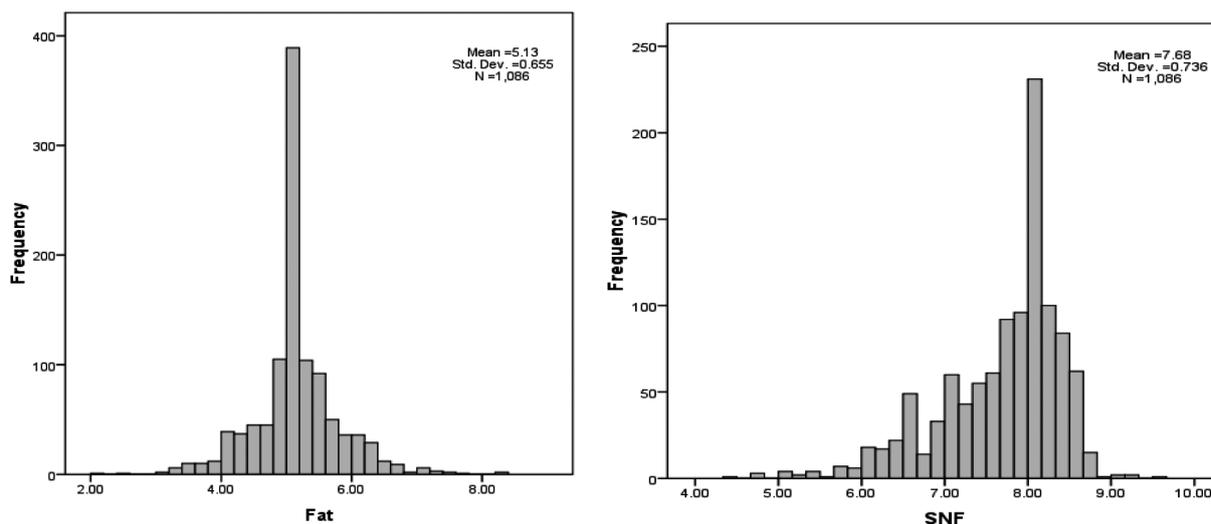


Figure 1. Histogram of fat (left) and SNF (right) content in Murrah crossbred buffaloes in Mid-western Terai region of Nepal

Average fat content

There was significant ($p < 0.01$) effect of all four seasonal variation to the milk fat %. Grand mean of fat % considering all the seasons' divulge 5.13 ± 0.019 % while autumn and spring season had also similar fat percent. Fat percent data showed a higher fat content, with a concomitant reduction in buffalo milk yield. During winter, the fat percent decreased to a minimum level, i.e. 4.98 ± 0.02 percent compared to 5.37 ± 0.67 percent during summer-humid months. Moreover, monthly variation in fat content of buffalo milk samples in this study (Figure 2) also shows roughly consistent values of this trait throughout the year. However, highest fat content was observed in the milk samples collected during June/July and lowest during October/November. ABD (2013) reported substantially higher value of fat content (6.15) of Murrah buffalo maintained under nationwide pedigree performance recording scheme (PPRS).

A decreasing fat percent trend associated with increased milk yield suggests that there is decrease in per unit rise in volume of milk, particularly during winter, and vice versa during summer and hot-humid months, reflecting a negative relationship between fat yield and milk yield (Nava-Trujillo et al., 2020). The decrease in fat % in winter season compared to the summer season is mainly due to the shortage of green grasses/forages from autumn to winter season due to the low level of humidity in the environment as well as low water absorption from the soil which alter the unavailability of forages (Nateghi, 2014). However Seasonal variations are well known in percentages of milk fat, with summer months averaging 0.4 percentage units less than winter months (Jenness, 1985). The summer higher ambient temperatures also affect the composition of milk fatty acids. Milk fat in the summer tends to be lower in palmitic acid compared with stearic and octadecanoic acids than milk fat in the winter from the same animals (Christie, 1979). Some of the changes in the amount of milk fat and composition with changes in temperature according to the changing seasons might be related to changes in blood plasma lipids, but nutritional changes often confound these findings. Milam, (1986) had reported no change in milk fat percentage when heat-stressed cows were given water at 10 or 28°C.

Average SNF content

SNF % was significantly affected by the season ($p < 0.01$), but with a minimum variation in the range. SNF % was higher during the spring season and it was lower in the summer season followed by autumn season and winter season (Table 2). A higher value of SNF content (8.25) of Murrah buffaloes maintained for nationwide pedigree performance recording scheme (PPRS) was reported by ABD (2013).

Table 2. Seasonal influence on Fat and SNF percent of buffaloes in mid-western Terai region, Nepal

Items	No. of observations	Fat %	SNF %
Grand Mean	1086	5.13±0.019	7.68±0.022
Range	1086	2 – 8.31	4.47 – 9.50
Seasons			
Spring (February-April)	176	5.13±0.04 ^b	7.87±0.04 ^a
Summer (May-July)	281	5.37±0.67 ^a	7.28±0.73 ^c
Autumn (August-October)	302	5.13±0.04 ^b	7.59±0.04 ^b
Winter (November-January)	327	4.98±0.02 ^c	7.82±0.03 ^a
Level of Significance		** ($p < 0.01$)	** ($p < 0.01$)
CV %		12.6%	9.2%

Note: **-Significant at $p < 0.01$; CV- Coefficient of Variation; SNF- Solid-not-fat.

In addition, Figure (2) clearly reflected the fact of monthly variation in SNF content of crossbred Murrah buffaloes in this study. Accordingly, highest SNF was recorded during November/December followed by May/June and it was lowest during July/August. The concentrations of milk components were negatively correlated with milk yield; and the percentages of milk fat, SNF and total solids decreased from calving to advanced lactation. Khosroshahi (2011) had also reported about similar result of SNF content for summer (6%) and spring season (7.5 %). This may be due to the high moisture availability and humidity in the environment during spring season, and perhaps also due to the dry climatic condition during summer season that are related to the thermoregulatory heat stress than in the spring season (Auldust, 1998; Phelan, 1982).

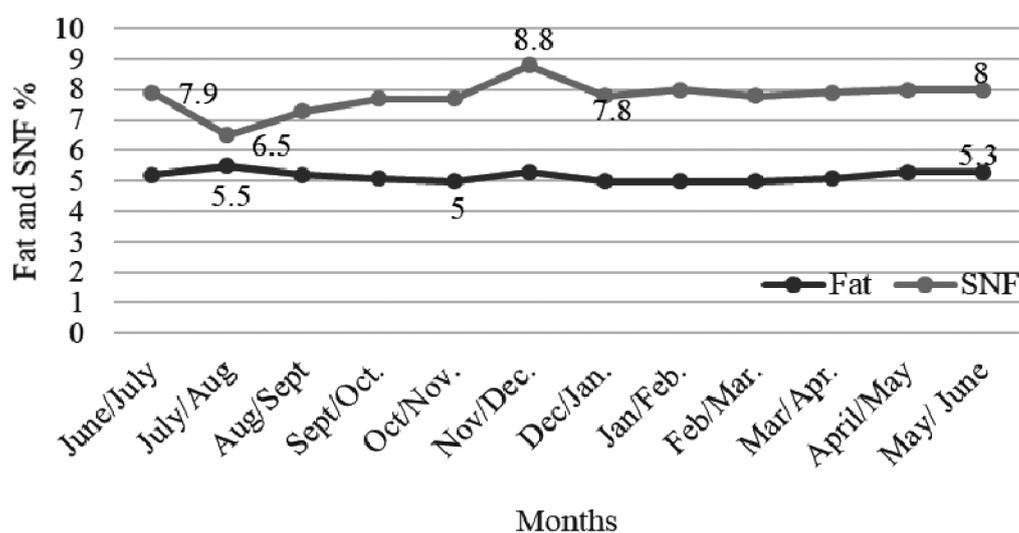


Figure 2. Monthly variation in fat and SNF content of Murrah crossbred buffaloes in Mid-western Terai region of Nepal

CONCLUSION

Findings of this research revealed a scientific fact about wider variation in milk yield, fat and SNF contents in crossbred Murrah buffaloes with the significant influence of season. This information could be useful in understanding the importance of synchronizing calving dates during spring season for higher production and productivity also maintaining the quality of milk, including fat and SNF content. Thus, it can be suggested that the season of calving would be useful to consider as one of the important sources of variation in a selection program. However, further investigation considering other environmental/non-genetic sources of variation including agro-ecological domains,

stage of lactation/parity, feeding and husbandry management required regarding genetic parameters determination of these traits covering wider population in the region.

Conflict of interest

The author declares that there is no conflict of interest.

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