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The effect of season on milk constituents and its physico-chemical properties in jersey crossbred cows

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Abstract
In order to optimize production strategies, ensure high quality products, and satisfy consumer demands throughout the year, it is essential to understand how seasons affect milk production and composition. The aim of present study is to find out how spring and summer season affect the milk production, composition and physico-chemical properties of Jersey crossbreds. Our result shows that the mean values of fat, protein, TS, SNF, lactose, freezing point, density, pH and specific gravity in spring were 4.997, 3.237, 13.095, 8.095, 4.472, -0.524, 28.975, 6.610 and 1.031, respectively, and in summer were 4.862, 3.145, 12.872, 8.008, 4.379, -0.516, 28.902, 6.581 and 1.031, respectively. The analysis of variance shows season has highly significant (p<0.01) effect on test day milk yield.

Keywords: Jersey crossbreds, season effects, milk composition, milk fat, milk protein, milk SNF, milk freezing point, milk pH

Introduction
The dairy industry is a vital component of global agriculture, providing a significant source of nutrition and livelihoods. It is important to note that milk serves as a primary source of nutrition for humans. There are several factors that influence the quality and quantity of milk, such as animal genetics, nutrition, and management practices. In addition, the season of production of milk can have a significant impact on its yield and composition. In today's market, milk prices are also based on the fat content of milk, mainly fat percentages (Sarkar *et al*., 2006) [11]. Several environmental factors can affect milk constituents as well as milk yields at successive stages of lactation and at completion of lactation and it becomes necessary to determine their relative importance so that Farmers can optimize their management practices, increase milk production, maintain milk quality, and ensure sustainability and profitability by recognizing and adapting to these effects. The purpose of this study is to investigate how different seasons affect milk yield and various compositional parameters such as fat, solids-not-fat, proteins, lactose, total solids, freezing point, density, pH, and specific gravity.

Material and Method
A total of 400 milk samples from 35 Jersey crossbred cows maintained at private dairy farm in Anjora, Dist- Durg (C.G) were collected at weekly intervals for a period from February to June. The district has a tropical climate. The Jersey crossbreds were housed in head-to-head system. They were always fed individually. The standard feeding and managemental practice were followed throughout the experimental period. Total experimental period was grouped in two seasons: Spring (Feb-April) and Summer (May-June). In each season 200 samples were analyzed. A sample of milk 30-40 ml was taken for analysis and cold chain was maintained using ice box. The samples collected were analyzed using Milkotester (milk analyzing device) for determination of Fat, SNF, Protein, Lactose, Density and Freezing point. The specific gravity and pH were determined by using lactometer and digital pH meter, respectively. Milk samples were taken from all healthy animals. The data collected were analyzed to see the effect of season on test day milk yield, milk composition and physico-chemical properties of Jersey crossbred cow's milk. Statistical analysis of data was done using analysis of variance to study the effect of season, parity and stage of lactation on Test day milk yield and on different milk components and somatic cell count. The following fixed effect model was used for the analysis:

$Y_{ijκlm} = μ + A_i + B_j + C_k + D_l + e_{ijκlm}$

Where,
Y ijklm = m^{th} observation under l^{th} milk yield, k^{th} parity, j^{th} stage of lactation and i^{th} season
μ = Overall mean
A_i = Effect of i^{th} season group
B_j = Effect of j^{th} stage of lactation group
C_k = Effect of k^{th} parity group
D_l = Effect of l^{th} milk yield group
e ijklm = Random error, NID (0,ó²e)

Result and Discussion

The overall mean for test day milk yield, major milk components and physico-chemical properties is given in [Table 1]. Milk production tends to decrease during hot summer months due to heat stress on cows (Gajbhiye *et al*., 2019, Dora *et al*., 2021 and Kumar *et al*., 2023) [4, 3, 7]. High temperatures can reduce feed intake, decrease rumination, and lead to overall discomfort, which negatively affects milk production. The analysis of variance shows that the fat content was significantly influenced by season. The overall mean of fat content was lowest in summer season 4.862±0.045 and highest in spring season 4.997±0.045 per cent. There was significant (p<0.05) effect of season on fat percentage [Table 2]. Several other workers have also reported seasonal fluctuation in fat percentage of milk in Jersey crossbred cows (Konwar and Sharma.1978; Sharma *et al*., 2002; Singh. 2008, Maheswari *et al*., 2018 and Lim *et al*., 2021) [6, 13, 14, 9, 8]. Some of the changes in milk fat percentage and composition with temperature change can be related to changes in blood plasma lipids, but these observations are also confounded by dietary changes.

Table 1: Overall mean values (±SE) of different milk constituents and physico-chemical parameters in different season

Milk constituents/ Physico-chemical properties	Spring	Summer
Test day milk yield(kg/day)	11.296±0.297	9.847±0.297
Fat (%)	4.997±0.045	4.862±0.045
Protein (%)	3.237±0.010	3.145±0.010
SNF (%)	8.095±0.028	8.008±0.028
Lactose (%)	4.472±0.013	4.379±0.013
Total solid (%)	13.095±0.059	12.872±0.059
Freezing point (°C)	-0.524±0.004	-0.516±0.004
Density	28.975±0.100	28.902±0.100
pH	6.610±0.006	6.581±0.006
Specific gravity	1.031±0.000	1.031±0.000

Table 2: Analysis of variance different milk constituents and physico-chemical parameters in different season

Effect of season	df	Sum of square	F
Test day milk yield	1	210.105	11.941**
Fat	1	1.836	4.495*
Protein	1	0.846	40.404**
SNF	1	0.764	4.969*
Lactose	1	0.856	23.749**
Total solid	1	4.977	7.031**
Freezing point	1	0.007	2.104
Density	1	0.533	0.265
pH	1	0.078	10.859**
Specific gravity	1	7.563	2.819

** Significant at p<0.01
*Significant at p<0.05

The analysis of variance showed that the effect of season on SNF percentage was significant (p<0.05). Singh (2008) [14] and Yogi *et al*. (2014) [15] were observed similar results to the present findings. Sharma *et al.* (2002) [13] and Maheshwari *et al.* (2018) [9] also revealed significant effect of seasons on SNF contents of milk of Jersey crossbred cows. In the present study highest mean value of SNF was reported in spring season, it is attributed to fact that the green fodder is available in that season, weather is also favorable to animal as compare to summer season.

Season has highly significant effect (p<0.01) on total solids as determined by analysis of variance. The mean values were found to vary among seasons. The present findings are similar to that of Maheshwari *et al*. (2018) [9] and Kabil *et al*. (2015) [5] who reported lower percentage of total solids in summer season and reported significant effect of season on TS content of milk. This might be due to less availability of grazing resources during summer. Sharma *et al.* (2002) [13] also showed seasonal variation being slightly lower value in summer. Contrary to this Sarkar *et al*. (2006) [11] reported that the milk of hot humid season possesses higher amount of milk constituents than that in other seasons. Nateghi *et al.* (2014) [10] also observed that summer milk has significantly higher TS content than winter milk. The variation in present findings may be due to difference in the agro-climatic condition of that area than other parts.

Present study also shows that Season had highly significant (p<0.01) effect on protein content of milk in Jersey crossbred cows [Table no.2]. The protein content was found to vary in different seasons. Arora and Bhojak (2013) [1] and Maheshwari *et al.* (2018) [9] found significant effect of season on milk protein content in Jersey crossbred cows, they found lower value of milk protein in summer which is similar to present study. Milk protein per cent was higher during fall and winter and lowest during spring and summer. This variation is related to changes in both the types of feed available and climatic conditions.

Season had highly significant (p<0.01) effect on milk lactose content in Jersey crossbred cows [Table no. 2]. Similar findings were also reported by Sarsiha (2004) [12] and Yogi (2014) [15] reported highly significant effect of season on lactose content of milk in HF crossbred cows. Whereas Maheshwari *et al.* (2018) [9] found non-significant effect of season on lactose content of milk, but the lactose content of winter season is slightly higher than the summer. It could be attributed to the chemical breakdown of body fat reserve during the summer season that maintain the normal glucose range in the animal blood and maintenance energy which in turn maintain milk carbohydrate supply.

The present study revealed that season had a non-significant effect on milk density of Jersey crossbred cows. The mean value of density and standard error of spring and summer season was 28.975±0.100 and 28.902±0.100, respectively. Nateghi *et al.* (2014) [10] also report non-significant effect of season on density of milk. The comparison of density of milk in different season with the other workers could not be made because of non-availability of sufficient information regarding this context. Season accounted no significant effect in the milk freezing point. The mean freezing point was found -0.524±0.004 and -0.516±0.004 in spring and summer, respectively. Czister *et al.* (2012) [2] reported that generally season did not have a significant influence on the freezing point of milk except for the difference between summer and winter, which reached significant level. The mean pH was found 6.610±0.006 and 6.581±0.006 in spring and summer, respectively. Seasonal influence on milk pH was found to be significant. Season had no significant effect on specific gravity of milk. The mean value of specific gravity was 1.031±0.00 and 1.031±0.000 in spring and hot summer.

Conclusion

The impact of seasonal variations on test day milk yield, milk composition and physicochemical properties is a complex and multifaceted phenomenon. The mean value of test day milk yield for spring and summer were 11.296±0.297 and 9.847±0.297 respectively**.** The average milk production was 10.571±0.212 kg during the period of study carried out in spring and hot summer. This average yield is better, when compared with production performance of Jersey crossbred cows reared during same season in other parts of the country. In the present study fat, SNF, TS, lactose and protein content are influenced by season. Understanding these seasonal fluctuations in milk quality is of utmost importance for both producers and consumers. Producers can use this knowledge to implement strategies to maintain and enhance milk quality year-round, thereby ensuring the consistency of their products. For consumers, awareness of these seasonal variations can inform choices related to dairy consumption and dietary preferences.

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