International Journal of Livestock Research, Vol. 14 (12) Dec' 2024
http://www.ijlr.org
eISSN: 2277-1964
NAAS Score:4.31

Original Research

Factors Affecting Test Day Milk Yield and Milk Constituents of Ongole Cattle

V. V. Potdar, Syed Meraj Ahmed Ismail, Srihari, D., B. Peddiraju, S. A. Joshi, B. Shivarudrappa, and J. R. Khadse

Central Research Station, BAIF Development Research Foundation, Urulikanchan Pune, INDIA

*Corresponding Author: vinod.potdar@baif.org.in

How to cite this paper
Potdar, V., Ismail, S. M. A., Srihari, D., Peddiraju, B., Joshi, S. A., Shivarudrappa, B., & Khadse, J. R. (2024). Factors Affecting Test Day Milk Yield and Milk Constituents of Ongole Cattle. *International Journal of Livestock Research*, 14 (12), 39-44.

Received : Aug 16, 2024
Accepted : Dec 11, 2024
Published : Dec 31, 2024

Abstract

The study's primary objective was to evaluate the influence of various non-genetic factors such as calving season, parity, and the stage of lactation on milk production and quality traits in Ongole cattle. By understanding these influences, the study sought to optimize management practices to improve milk yield and quality in this indigenous breed. The study sought to explore the impact of non-genetic factors on test-day milk yield and various milk quality parameters in Ongole cattle. 1,105 animals with 12,182 records were assessed between 2017 and 2022 in the Guntur district of Andhra Pradesh. The least-squares mean values for test day milk yield, fat%, SNF%, protein%, and lactose% were found to be 3.03 ± 0.18, 3.55 ± 0.16, 9.40 ± 0.10, 3.49 ± 0.06, and 5.15 ± 0.05, respectively. The analysis underscored the significant influence of calving season, parity, and stage of lactation on the yield, fat, protein, SNF, and lactose content. The results highlighted that calving season considerably impacted test-day milk yield and composition traits. Animals calving in winter exhibited a significantly higher yield and better fat and protein percentages than those calving in summer. Parity, or the number of lactations, also influenced milk production, with cows in their third lactation producing higher yields compared to their first lactation. Additionally, the stage of lactation played a critical role, where milk yield was highest during the early lactation period, and gradually decreased as the lactation advanced. This study concludes that non-genetic factors, specifically calving season, parity, and stage of lactation, significantly influence the milk yield and quality traits in Ongole cattle. Management interventions focusing on seasonal feeding strategies, optimal lactation management, and attention to parity can enhance the production efficiency of Ongole cattle. The study's findings provide crucial insights into improving the productivity of this indigenous breed, thereby enhancing its contribution to the dairy industry in India.

Keywords: Fat, Lactose, Ongole Cattle, Protein, SNF, Test Day Milk.

Introduction

Ongole cattle or Nellore is also the name given to an indigenous breed of Andhra Pradesh, India. Originating in the coastal districts of Guntur, Prakasam, and Nellore, Ongole is very famous for its dual purposes: as a draught animal and a source of milk. Thus, this variety of cattle breeds is crucial for the agrarian communities belonging to this region for economic and financial purposes. This breed is more appreciated for its outstanding durability to survive the tropical climate with very high heat resistance and survives on poor feed provision and with less fodder supply during dry weather when forages are scarce. In addition to the physical characteristics, the Ongole cattle possess a gentle nature that helps in easy handling and milking. This docility is helpful in dairy farming situations where a stressful environment can impair either animal welfare or productivity. Adverse climate production scenarios make this breed especially worthy for the farmers concerned with consistent dairy yield output without regard to favourable breeding surroundings. This research aims to investigate the effects of non-genetic factors on production traits in Ongole breeds regarding test day milk yield, fat percent, protein percent, SNF percent, and lactose percent. The present study would identify better management practices that can be optimized to enhance milk production in Ongole cattle, thereby contributing to the sustainable development of the dairy industry in India.

Materials and Methods

The present study was conducted in the Guntur district of Andhra Pradesh, focusing on Ongole cattle. The productivity and milk quality of these animals, influenced by both genetic and non-genetic factors, have been a subject of continuous interest. The study aimed to assess the impact of non-genetic factors such as parity, season, and stage of lactation on the test day milk yield and milk constituents like fat, SNF (Solids Not Fat), protein, and lactose percentages. The data for this study was collected from the Guntur district, covering a period from 2017 to 2022. A total of 1,105 Ongole cattle, with 12,182 lactation records, were included in the analysis. The milk components were analyzed using a Nuline Milk Scanner developed by GHT SoftTech, which provided accurate values for the different milk constituents.

Grouping of Variables

To analyze the influence of non-genetic factors, the following groups were considered:

1. Parity Groups: First parity to 5th Parity and above
2. Calving Seasons:
    - Rainy Season: July to September
    - Summer Season: March to June
    - Winter Season: October to February
3. Stages of Lactation:
    - Stage 1: 5–90 days
    - Stage 2: 91–180 days
    - Stage 3: 181–305 days

The statistical analysis of the data was conducted using R software, a powerful tool widely utilized in statistical computing and data analysis. The primary focus was on employing the least-squares method to accurately assess the influence of various non-genetic factors on milk yield and the constituents of milk in Ongole cattle. This method allows for the estimation of the least-squares means, which represent the adjusted average values for specific traits, effectively accounting for the variability introduced by other influencing factors such as parity, calving season, and stage of lactation. By controlling for the effects of the above-mentioned factors, these means offer a clearer understanding of the true production potential of the Ongole breed. This analysis facilitates a deeper understanding of how various factors interact and affect milk production traits. Overall, the combination of least-squares means and ANOVA provides a comprehensive statistical framework for evaluating the impact of non-genetic factors on

milk production in Ongole cattle.

Results and Discussion

The study assessed various milk and milk constituent traits in Ongole cattle over five years (2017-2022), focusing on test-day milk yield across different lactations. The overall least-squares mean for test-day milk yield across different lactations was found to be 3.03 ± 0.18 kg, which aligns with the findings of Vinoo *et al*. (2005), who reported a similar average milk yield of 3.02 ± 0.05 kg in Ongole cows. In the present study, the test-day milk yield was affected by the order of parity, the stage of lactation ($P \leq 0.05$) and also season of calving. Vinoo *et al*. (2005) reported similar significant parity effect on milk yield. The least-squares means for the milk constituents as fat, solids-not-fat (SNF), protein, and lactose percentage was calculated to be 3.53 ± 0.01%, 8.55 ± 0.02%, 3.29 ± 0.01%, and 5.35 ± 0.03%, respectively, as shown in Table 2. Sudhakar *et al*. (2013) reported similar least-squares means for fat (3.31 ± 0.18%), SNF (9.34 ± 0.12%), protein (3.51 ± 0.08%), and lactose (5.12 ± 0.07%), which are comparable to the findings in the current study. Gaur *et al*. (2002) also observed a higher fat percentage and lower SNF, mirroring the results of this study. All milk composition traits were influenced by the order of parity, stage of lactation and season of calving.

Influence of Non-Genetic Factors on Milk Yield and Constituents in Ongole Cattle

The study also investigated the impact of non-genetic factors such as calving season, parity, and stage of lactation on milk yield and milk constituent traits (fat, solids-not-fat, protein, and lactose). These factors play a significant role in shaping the lactational performance and milk quality of Ongole cattle. The results and their interpretations are presented below:

Parity

The cows were grouped into five parity levels ranging from first parity to fifth and above. Parity refers to the number of times a cow has given birth, which is directly linked to milk production Lower milk yields were observed in cows in their first and second parties Chakravarthy *et al*. (2002) observed an almost similar effect of parity. This is consistent with findings in other breeds, where younger cows produce less milk as their physiological systems are not fully matured for peak production (Singh *et al*., 2018). Cows in their fourth & above parties showed higher milk yields. In the present study highest test day milk was observed in the 4^{th} parity at 3.45±0.03 while the highest fat & protein % was observed in the 5^{th} & above parity at 3.67±0.03 & 3.42±0.03. SNF % was highest in 1^{st} parity at 8.98±0.02 while lactose was highest in the second parity at 5.40±0.02. This increase is commonly observed as cows reach their peak lactational productivity during their middle reproductive years. Studies on Sahiwal and Gir cattle have demonstrated similar trends, where cows in mid-parity (third and fourth) tend to have the highest yields (Vinoo *et al*., 2005).

Calving Season

The calving season was divided into rainy, summer, and winter seasons to analyze its impact on milk yield and fat percentage. The highest average test day milk yield 3.44±0.02 and fat % 3.63±0.01 was recorded during the rainy season. This can be attributed to the availability of green fodder, which provides better nutrition and contributes to higher milk production and an increase in milk fat content. Cows calving during the summer exhibited lower test day milk yields 3.20±0.02 which can be explained by the heat stress that affects both milk production and fat synthesis. Research by Sharma *et al*. (2022) highlighted that high environmental temperatures reduce feed intake and milk yield, particularly in tropical breeds. Cows calving in winter showed intermediate levels of milk production 3.24±0.01. The cooler weather helps minimize heat stress, though the availability of green fodder may not be as abundant as in the rainy season. The highest SNF% and lactose % were recorded in the winter season as 8.75±0.01 & 5.46±0.03. Protein% was highest in summer as 3.44±0.01.

Stage of Lactation

The lactation period was divided into three stages to assess the effect of time postpartum on milk yield and milk constituents. As Stage 1 (5-90 days postpartum), Stage 2 (91-180 days postpartum) & Stage 3 (181-305 days postpartum). Test day milk yield was highest during the early lactation period 4.19±0.02. This early stage is marked

by peak milk production, as cows have just calved and are physiologically primed for lactation. Similar findings have been reported in both indigenous and crossbred cows, with peak yields occurring in the first 90 days (Sharma *et al*., 2022). Highest fat% & protein % was recorded in last stage as - 4.17±0.01 & 3.72±0.01 while highest SNF% & lactose % was observed in first state as - 8.76±0.02 & 5.63±0.02. Fat and protein concentrations began to increase during third stage, indicating that as total milk volume decreases, the concentration of solids in the milk increases, which improves milk quality. The lowest milk yields were recorded in the late lactation phase. Despite the drop in volume, there was a significant increase in SNF and protein content, which has also been observed in other tropical breeds like Tharparkar and Red Sindhi (Sharma *et al*., 2022). The corresponding yields for the milk constituents' fat, SNF, protein, and lactose were calculated as 28.83 ± 0.11 kg, 78.36 ± 0.49 kg, 27.20 ± 0.11 kg, and 46.53 ± 0.37 kg, respectively. Similarly, Navav Singh *et al*. (2021) found comparable results in his research on Kankrej, Sahiwal, and Rathi breeds from the semi-arid region of Rajasthan, India. In the present study, the protein percentage was recorded at 3.29 ± 0.01%, which is slightly higher than the lower milk protein content reported by A.K. Wankar *et al*. (2020) in Red Kandhari cattle. The lactose percentage in this study was 5.35 ± 0.03%, which was found to be higher than the 5.15 ± 0.05% reported by Krovvidi *et al*. (2013). A highly significant effect of parity was observed across all traits, with milk yield per day of lactation increasing progressively from the first to the fourth lactation. This confirms that cows achieve better physiological development as they age, which enhances their productivity. Ravi Kiran *et al*. (1995) similarly reported a significant influence of the order of lactation on total milk yield, 305-day lactation yield, and calving interval. Present study also found a highly significant effect of calving season on all the traits examined. Ashwani Kumar *et al*. (2016) documented a similar significant impact of parity on milk yield per day in Ongole cows. In contrast, Krovvidi *et al*. (2013) reported that none of the milk composition traits were influenced by the order of parity or the stage of lactation, whereas in the current study, all milk composition traits were affected by these factors. The significant influence of seasons on various traits may be attributed to changes in feeding and management practices during different periods. Kumar *et al*. (2003) and Chakravarthy *et al*. (2002) observed a significant effect of the period of calving on lactation milk yield in Ongole cows. However, Vinoo *et al*. (2005) and Singh *et al*. (2004) found that the season did not significantly impact lactation milk yield. The period of calving also influenced other productive and reproductive traits of Ongole cattle in the present study. These significant differences in the productive and reproductive traits of Ongole cows across different periods could be attributed to variations in nutritional and environmental factors. The descriptive statistics for the milk constituents of Ongole cattle are presented in Table 1, summarizing key measures such as fat, solids-not-fat (SNF), protein, and lactose. Additionally, the overall least squares mean, along with the means for various calving seasons, parities, and stages of lactation, including their corresponding standard errors, for different milk yield and constituent traits, are detailed in Table 2. These tables provide a comprehensive overview of the variation in milk production and quality across the evaluated non-genetic factors.

Table 1: Descriptive Statistics for the Milk Constituents of Ongole Cattle

Traits	Mean ± S.E.
Test Day Milk Yield	3.03 ± 0.18
Fat %	3.55 ± 0.16
SNF %	9.40 ± 0.10
Protein %	3.49 ± 0.06
Lactose %	5.15 ± 0.05
Fat yield (kg)	28.83±0.11
SNF yield (kg)	78.36±0.49
Protein yield (kg)	27.20±0.11
Lactose yield (kg)	46.53±0.37

Comparative Findings and Discussion

When comparing these results with other studies, the overall milk yield and constituent levels are in line with previous reports on indigenous breeds. The fat percentage in the current study, for example, is consistent with values reported by various authors for other indigenous Indian breeds like Gir and Sahiwal. Similarly, the increase in SNF and protein in later stages of lactation aligns with the findings of Sharma *et al*. (2022), who documented similar patterns in tropical cattle breeds. The moderate fat percentage (3.53 ± 0.01%) observed in the Ongole cattle is also comparable to that in Bargur cattle, another indigenous breed, making Ongole cows suitable for regions requiring

dairy products with moderate fat content. Moreover, the lactose percentage (5.35 ± 0.03%) is higher than that reported in some other tropical breeds, which enhances the nutritional quality of Ongole milk.

Table 2: Least-square Mean and Standard Errors for Various Factors Affecting Different Constituents of Milk of Ongole Cattle

	Animals count	records count	TDMY (kg)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)	Fat Yield (Kg)	SNF Yield (Kg)	Protein Yield (Kg)	Lactose Yield (Kg)
Overall μ	1105	12182	3.31±0.02	3.55 ± 0.16	8.55±0.02	3.29±0.01	5.35±0.03	28.83±0.11	78.36±0.49	27.20±0.11	46.53±0.37
Parity											
1	739	3744	3.33±0.02	3.26±0.01	8.98±0.02	2.99±0.01	5.29±0.03	29.6±0.09	81.50±0.34	27.2±0.11	46.1±0.36
2	595	3720	3.13±0.01	3.56±0.01	8.46±0.01	3.30±0.02	5.40±0.02	27.5±0.10	74.30±0.30	26.01±0.10	43.8±0.25
3	479	3152	3.24±0.02	3.57±0.01	8.53±0.02	3.34±0.01	5.31±0.03	29.1±0.11	78.4±0.33	27.4±0.11	46.3±0.41
4	157	1065	3.45±0.03	3.63±0.02	8.38±0.03	3.41±0.02	5.43±0.08	29.6±0.31	80.4±0.61	28.2±0.20	48.3±0.86
5 and above	56	501	3.41±0.05	3.67±0.03	8.4±0.04	3.42±0.03	5.35±0.07	28.3±0.31	77.2±0.9	27.2±0.30	48.1±0.88
Stage of lactation											
1 (5–90 days)	798	3232	4.19±0.02	2.90±0.01	8.76±0.02	2.88±0.01	5.63±0.02	27.4±0.12	75.40.36	25.9±0.12	45.4±0.40
2 (91–180 days)	950	3818	3.62±0.02	3.55±0.01	8.52±0.01	3.28±0.01	5.39±0.01	29.5±0.12	80.20.35	27.8±0.12	46.9±0.36
3 (181–305 days)	1018	5132	2.13±0.01	4.17±0.01	8.36±0.01	3.72±0.01	5.04±0.03	29.5±0.11	79.6±0.33	27.8±0.11	47.4±0.35
Season of calving											
Rainy	789	3393	3.44±0.02	3.63±0.01	8.57±0.02	3.19±0.01	5.35±0.02	29.2±0.12	78.7±0.35	27.3±0.11	47.3±0.37
Summer	834	2518	3.20±0.02	3.51±0.01	8.32±0.02	3.44±0.01	5.25±0.01	29.5±0.12	78.2±0.39	27.5±0.13	47.2±0.40
Winter	1064	6271	3.24±0.01	3.47±0.01	8.75±0.01	3.24±0.01	5.46±0.03	27.8±0.10	78.2±0.31	26.8±0.10	45.1±0.35

Conclusion

The study highlights the significant influence of non-genetic factors such as calving season, parity, and stage of lactation on milk production and quality in Ongole cattle. These results are consistent with earlier research on tropical and indigenous cattle breeds. The rainy season, middle parities (third and fourth), and early lactation periods are associated with higher milk yields, while the later stages of lactation result in an increase in the quality of milk, particularly in terms of SNF and protein content. These findings are crucial for optimizing milk production and management practices in tropical dairy farming systems.

Acknowledgements

The authors are thankful to State in charge of BAIF team and field team for data collection and all stakeholders in study area those who participated and cooperated during study.

Contribution by Authors

Each co-author contributes equally.

Conflict of Interests

There is no conflict of interest.

Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

References

1. Ak Wankar, Pm Kekan, Sb Daware, Manimaran S, Bagadhe P And Buktare MR (2020) Journal of Entomology and Zoology Studies Effect of THI and other environmental variables on milk constituents in red Kandhari cattle and Marathwadi Buffaloes E-ISSN: 2320-7078 P-ISSN: 2349-6800 www.entomoljournal.com JEZS 2020; 8(2): 1372-1376
2. Ashwani Kumar, Umesh Singh, Rajbir Singh and R Vinoo (2016) Genetic studies on production and reproduction traits of Ongole cattle at organized farms *Indian Journal of Animal Sciences* 86 (7): 826–830, July 2016
3. Chakravarthy K, Bidarkar D K, Ramesh G B, Rao G N and Sudhakar K. 2002. Production and reproduction traits of Ongole cattle. *Indian Journal of Animal Science* 72(10): 908– 10.
4. Navav Singh, Sanjita Sharma , Vishnu Sharma , Sita Ram Gupta , Govind Singh Dhakad and Satendra Kumar Yadav (2022) Association of breed and non-genetic factors with freezing point and milk attributes of Zebu cattle *Indian Journal Dairy Science* 75(2): 144-150
5. Ravi Kiran G, Rao G N, Jayaramakrisl~na V and Satyannrayana A. 1995. Performance of Qngole and crossbred cotrs under village conditions of Andhra Pradesh. *Indian Journal of Animal Sciences* 65: 780-84.
6. Sudhakar Krovvidi, S. Panneerselvam, A. K. Thiruvenkadan, J. Johnson Rajeswar, K. Sivakumar, R.Vinoo (2013) Lactation Performance and Milk Constituents of Ongole Cattle in Its Breeding Tract
7. Gaur, G.K., Kaushik, S.N. and Garg, R.C. (2002). Ongole cattle status in India. Animal Genetic Resources Information. 32: 27-34
8. Krovvidi S, Panneerselvam S, Thriruvenkadan AK, Rajeswar JJ, Sivakumar K, Vinoo R.(2013) Lactation performance and milk constituents of Ongole cattle in its breeding tract. *Research and Reviews: Journal of Veterinary Science and Technology*. 2013; 2(2):8-11.
9. Kumar D K, Reddy C E, Gupta B R and Satyanarayana A (2003) Effect of year, season and lactation order on the performance of Ongole cattle. *Indian Journal of Animal Sciences* 73(11): 1289–90.
10. Vinoo R, Rao G N, Gupta B R and Rao K B. 2005. Genetic study on productive and reproductive trait of Ongole cattle. *Indian Journal of Animal Sciences* 75(4): 43–441p
11. Singh J, Singh CV (2018) Effect of non-genetic factors on pooled productive and reproductive traits in Sahiwal cattle. Veterinary Medical Open Journal. 2018; 3(1): 16-20

****