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Correlation study on various milk production and milk composition traits in Gir and Mulki cattle in Narmadapuram division of Madhya Pradesh state

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Abstract
This study was planned to find out interrelationship among various milk production and milk composition traits in Gir and Mulki cattle of Narmadapuram division of Madhya Pradesh state. The data was collected from 75 healthy cows comprises of 40 Mulki and 35 Gir cattle in. Various milk production traits including daily milk yield (DMY), milk yield (MY) and lactation length (LL) were recorded. About 50 ml milk was collected from each cow to analyse various milk composition traits *viz.,* Fat%, SNF%, Density, Lactose%, Protein%, water content, pH and Freezing point (FP) etc. The data generated was subjected to correlation coefficient analysis. The correlation between different milk yield and milk composition traits was ranged from -0.621 (LL and DMY) to +0.714 (DMY and MY) in Gir cattle and from -0.321 (FP and pH) to +0.940 (DMY and MY) in Mulki cattle. Milk yield showed positive correlation with DMY, LL and density, whereas it showed negative correlation with fat, protein and lactose percent in Gir cattle. In Mulki cattle, milk yield exhibited positive correlation with DMY, LL and protein (%), whereas it showed negative correlation with fat %, SNF %, lactose % and density. This study was the first attempt to study the correlation among various milk production and milk composition traits in Gir and Mulki cattle in Narmadapuram division of Madhya Pradesh state.

Keywords: Cattle, correlation, Gir, milk, Mulki, Narmadapuram

1. Introduction
Livestock sector plays a vital role in India's economy and provide livelihood support to millions of people having little access to land in the country. About one-third of the population lives below the poverty line, mainly comprising of landless, marginal and small farmers. According to 20th livestock census, the total number of cattle in the country is 193.46 million showing an increase of 0.8 percent over previous census (BAHFS, 2021) [1]. Madhya Pradesh (M.P.) state possesses 18.7 million cattle which is around 9.7% of country's total cattle population. This state possesses some valuable cattle breeds like Kenkatha, Gaolao, Malvi, Nimari and substantial populations of some non-descript cattle such as Mulki, which is primarily found in Betul district in Narmadapuram division.
Milk is one among the necessary component in the human diet, rich in nutrients like protein, fat, carbohydrate, vitamins and minerals etc. The production and consumption of cow milk is the highest throughout the world (Strzalkowska *et al.,* 2009) [2]. Milk production, milk composition and reproductive efficiency etc. are the traits which are considered crucial in dairy cattle and contribute to the economy of the dairy herd (Alphonsus and Essien, 2012) [3]. Prior information of the relationship among these traits is necessary in the formulation of an efficient breeding programmes. Since one trait in animal is often interrelated with others, therefore multi-trait selection should consider for improvement of the animals. In this way, the correlations coefficient which predicts the change in one trait in response to other estimates the utility of multi-trait selection and forecast the comprehensive outcomes of a selection programme for traits of economic importance (Wattiaux 2002) [4].
Non-descript population of indigenous livestock are very crucial for sustainable livestock husbandry, especially in village or remote area. Keeping these facts in mind, the present study was designed to assess the interrelationship among various milk production and milk composition traits of local Mulki and Gir cattle in Narmadapuram division of M.P.

2. Materials and Methods
2.1 Location
The present study was conducted at Betul district and Timarni tehsil of Harda district of Narmadapuram division of M.P. Narmadapuram is one among the ten divisions of M.P., comprises of three districts Betul, Harda and Narmadapuram, respectively (Fig. 1). District Betul is the largest district which forms the southernmost boundary of the division and located at longitude 21.92°N and latitude 77.9°E whereas the district Harda forms the western boundary and located at 22.33°N 77.1°E. This region has a tropical wet and dry climate with three distinct seasons. The average annual temperature of district Betul remains around 28.01 ℃ with average annual relative humidity of 49.84% and receives 134.77 mm of precipitation. Similarly, annual average temperature of district Harda remains around 30.04 ℃. It receives about 152.35 mm of precipitation and average annual relative humidity around 46.52% (Weather and Climate, 2023) [5].
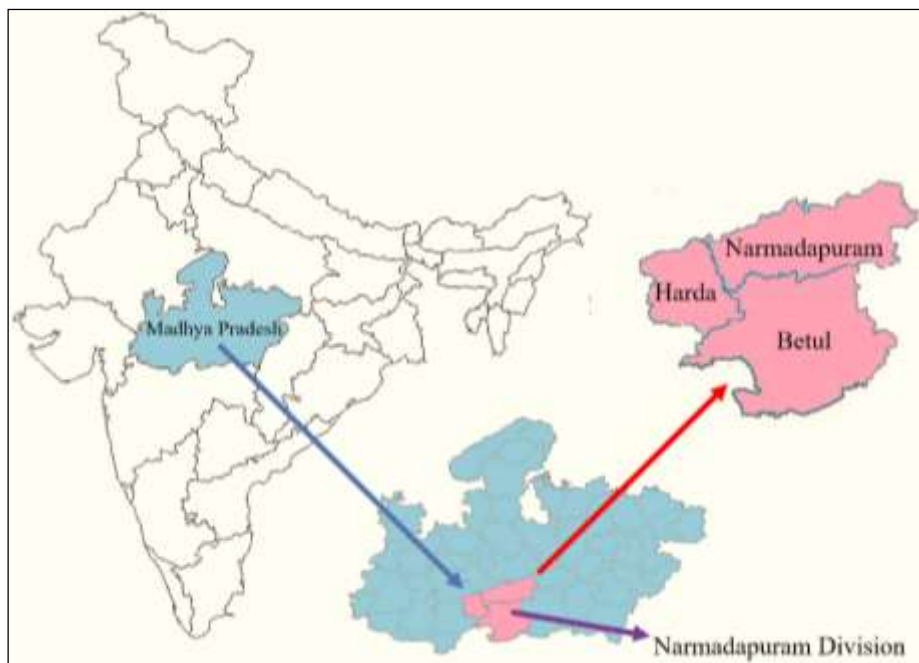

Fig 1: Geographical location of Narmadapuram division of M.P.

2.2 Experimental Animals
The present research work comprised of total 75 cows of local Mulki (n=40) and Gir (n=35) cattle of Betul district and Timarni tehsil of Harda district of Narmadapuram division (M.P.) under "Madhya Pradesh Biodiversity Board Project" entitled "Survey, Documentation of ITK and Phenotypic Characterization of Non-Descript Breed of Cattle in Narmadapuram Division of Madhya Pradesh".

2.3 Milk Production and milk composition analysis
All the experimental cows were hand milked twice daily (morning and evening). The daily milk yield (DMY) was recorded in litres and this record was used to estimate milk yield (MY) and lactation length (LL). About 50 ml milk was collected from each of the above 75 cattle, these milk samples were brought to the laboratory in cold chain and were processed for analysing of milk composition traits *viz.,* Fat%, SNF%, Density, Lactose%, Protein%, water content, pH, Freezing point (FP) etc. The laboratory procedures for the milk sample preservation and analysis were carried out at College of Veterinary Science and Animal Husbandry, Jabalpur (M.P.). by using Lactoscan Milk analyzers (Proscan+).

2.4 Statistical Analysis
The data generated during the experiment was subjected to correlation analysis using computer statistical software IBM SPSS (Version 25.0) to find out the relationship among the traits.

3. Results and Discussion
The correlation between different milk yield and milk composition traits was ranged from -0.621 (LL and DMY) to +0.714 (DMY and MY) in Gir cattle (Fig. 2) and from -0.321 (FP and pH) to +0.940 (DMY and MY) in Mulki cattle (Fig. 3). Milk yield showed significant ($p<0.01$) positive correlation with DMY and non-significant ($p>0.05$) positive correlation with LL and density, whereas it showed negative and non-significant ($p>0.05$) correlation with fat, protein and lactose percent in Gir cattle (Fig. 2). In Mulki cattle, milk yield exhibited significant ($p<0.01$) positive correlation with DMY and non-significant ($p>0.05$) positive correlation with LL and protein (%), whereas it showed significant ($p<0.05$) negative correlation with fat % and non-significant ($p>0.05$) negative correlation with SNF %, lactose % and density (Fig. 3).

The present outcomes of correlation between milk yield and fat% in Mulki cattle was in agreement with Strzałkowska *et al.* (2009) [2]. However, unlike non-significant ($p>0.5$) negative correlation between milk yield and fat % in Gir, they reported significant ($p<0.05$) negative correlation in goats. Like present outcomes in Gir and Mulki cattle, Alphonsus and Essien (2012) [3] also reported positive correlation between LL and MY however their value of correlation coefficient was significant ($p<0.05$). In agreement to present findings for correlation coefficients between fat % and protein % in Mulki cattle, Alphonsus and Essien (2012) [3] also reported non-significant ($p>0.05$) negative correlation, however their findings are unlike the present findings- for Gir cattle, as it was found to be positive in present study.
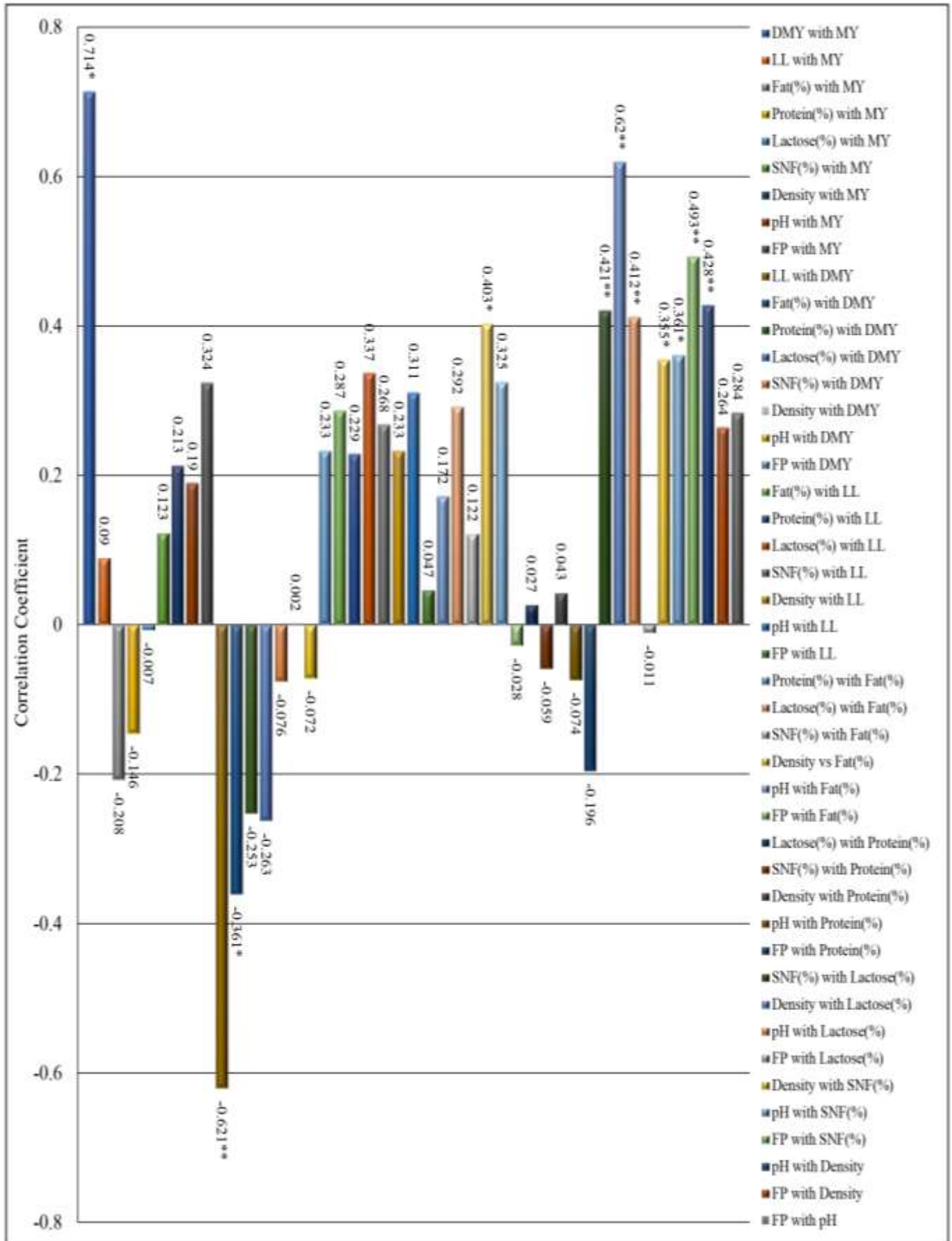
Fig 2: Pearson correlation coefficients among the milk yield and milk composition traits in Gir cattle *Significant ($p<0.05$), **Highly significant ($p<0.01$), MY-Milk Yield, DMY-Daily Milk Yield, LL-Lactation Length, SNF-Solid Non-Fat, FP-Freezing Point
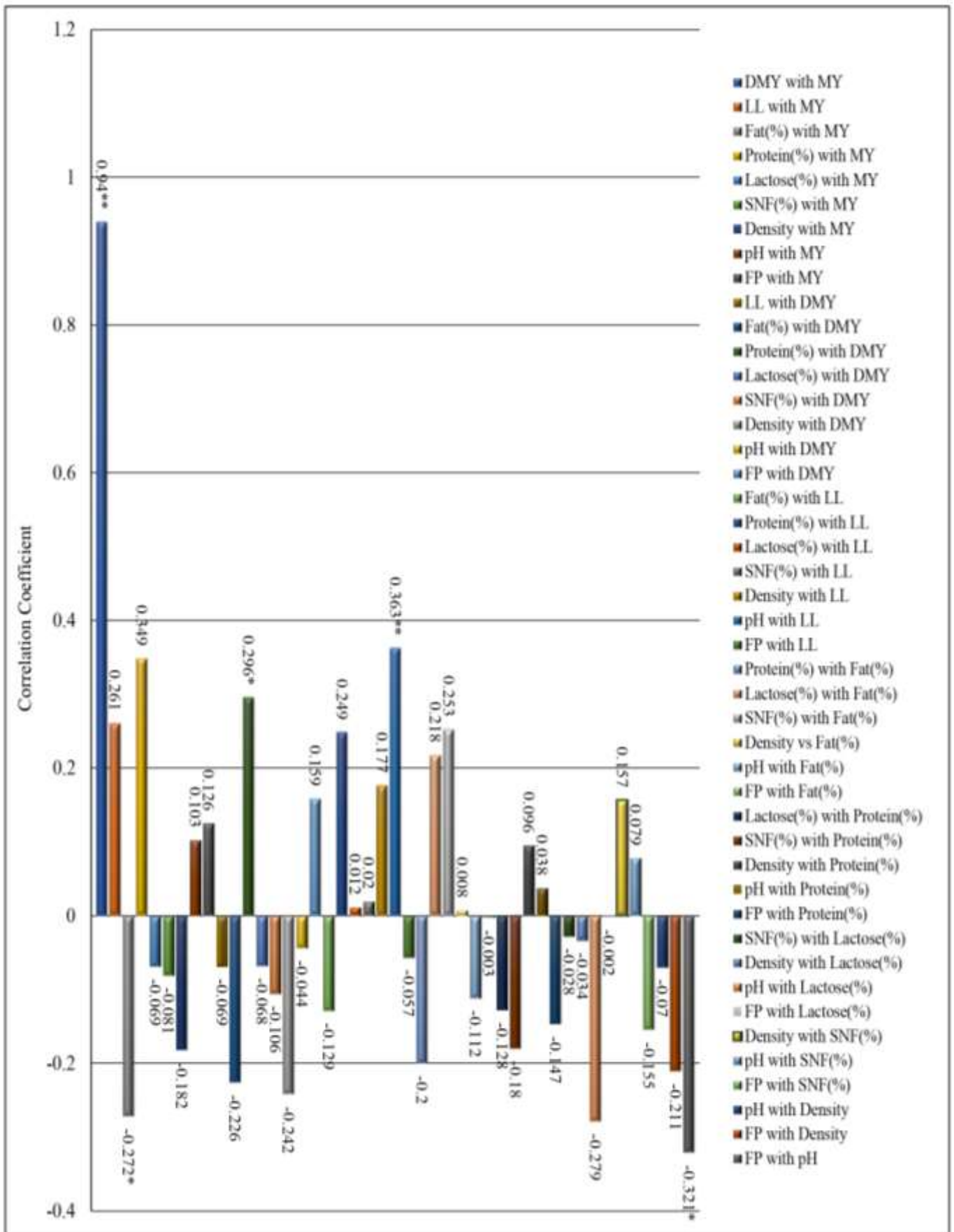
Fig 3: Pearson correlation coefficients among the milk yield and milk composition traits in Mulki cattle *Significant ($p<0.05$), **Highly significant ($p<0.01$), MY-Milk Yield, DMY-Daily Milk Yield, LL-Lactation Length, SNF-Solid Non-Fat, FP-Freezing Point

The present outcomes for corelation coefficient between SNF % and protein % in Gir and Mulki cattle, was in accordance to findings of Alphonsus and Essien (2012) [3], as they also

reported non-significant ($p>0.05$) negative correlation. The present findings for correlation between SNF % and fat % were also in accordance to Alphonsus and Essien (2012) [3],

they reported positive correlation, however it was found to be non-significant ($p>0.05$). Correlation between MY and fat % was negative and significant ($p<0.05$) in Mulki cattle but negative and non-significant in Gir cattle in present outcomes, anyhow these findings were in agreement with Alphonsus and Essien (2012) [3], however they reported it non-significant. Outcomes for correlation between MY and SNF % were in accordance with Alphonsus and Essien (2012) [3] in Mulki cattle but in discordance in Gir cattle, as it was found to be positive in present study. Similary outcomes for correlation between LL and fat % were in agreement with Alphonsus and Essien (2012) [3] in Mulki cattle but in disagreement in Gir cattle, as it was found to be positively correlated in present study. However, findings for correlation between LL and SNF% in present study were in agreement with Alphonsus and Essien (2012) [3] in both Gir and Mulki cattle.

4. Conclusion
Milk yield was found to be positively correlated with daily milk yield, lactation length and SNF% but negatively correlated with fat %, protein % and lactose % in Gir cattle in present study. However, in Mulki cattle, milk yield was found to be positively correlated with daily milk yield, lactation length and protein % but negatively correlated with fat %, lactoe % and SNF %. Further, validation of this data is needed by estimating the correlation coefficient in larger population. Although this preliminary study, might be proven to be helpful for making an inference about the milk production and milk composition traits in Gir and Mulki cattle in Narmadapuram division of Madhya Pradesh state.

5. Acknowledgement

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