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Genome-wide correlation study between milk composition traits and different genetic variants of αs2 casein gene in Nimari cow of M.P., India

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Abstract
This study aimed to investigate the genetic variants and their correlation with milk production traits in Nimari cattle of Madhya Pradesh at αS2 casein gene (CSN1S2) locus. Daily Milk yield showed that there was a positive and highly significant correlation with milk yield of both AA and AB genotype of αs2-casein gene in Nimari cow. Lactation length showed Positive and significant correlation with milk yield (MY) but significant and negative correlation with daily milk yield trait in AA genotypes. Whereas AB genotypes showed non-significant but negative correlation with milk yield and daily milk yield of Nimari cow. In AA genotype of Nimari cow, Fat % showed significant but negative correlation with milk yield) and lactation length whereas in AB genotype Fat % also showed high and significantly negative correlation with both milk yield daily milk yield trait and Lactation length of Nimari cow. In AA genotype of Nimari cow, Fat % showed significant but negative correlation with milk yield and lactation length whereas in AB genotype Fat % also showed significantly negative correlation with both milk yield daily milk yield trait and Lactation length of Nimari cow. Milk protein of AA genotype showed non-significant and negative correlation with Milk yield Daily milk yield and Lactation length but non-significant and positively correlated with Fat % whereas Significant but negative correlation noticed between milk protein of AB genotype of Nimari cow and Fat % and remaining traits Milk yield and daily milk yield showed non-significant and positive correlation with Protein. Highly significant and positive correlation noticed between lactose and milk protein whereas lactose showed non – Significant but positive correlation with Milk yield and Daily Milk Yield and Lactation length. AA genotype of Nimari cow milk SNF showed non – Significant but negative correlation with Milk yield and lactation length (-0.17) whereas, Fat % Protein and lactose are showed highly significant and positive correlation with SNF. SNF of AB genotype in Nimari breed cow showed Highly significant and positive correlation with Fat % and lactose whereas with rest trait SNF showed non- significant correlation. Non-significant and negative correlation showed by milk density with Milk yield Lactation length and SNF. Milk density of AB genotype of Nimari cow showed highly significant and positive correlation with milk protein Lactose SNF and milk yield whereas milk density showed negative but non-significant correlation with Fat %.

Keywords: αS2, casein gene, Nimari, protein, lactose and SNF.

1. Introduction
This study aimed to explore the association of different genetic variants of Nimari cattle with its milk production traits. Milk secures the cognitive development, health and growth of mammalian neonates by the mother, offering a tailored cocktail of Fat, Protein and Lactose together with essential vitamins and minerals, as well as an overwhelming number of minor bioactive components (German *et al.*, 2002) [7]. As per the Goddard and Hayes, (2009) [8] genome-wide association studies provide valuable information regarding molecular basis of the traits, but in terms of dairy animal breeding programs, the estimation of genetic gain and merit is more important. In last 20 years, in milk genomics studies more number of major QTL regions, DGAT1 on BTA14, SCD1 on BTA26, FASN on BTA19, as well genes for major milk proteins such as the casein gene cluster on BTA6, PAEP on BTA5 noticed. According to Ogorevc *et al.* (2009) [15] total yields of milk, protein and fat influence by specific genes or regions. Caroli *et al.* (2009) [4] noticed a number of common and rare variants in milk protein variants. Farrell *et al.* (2004) [6] revealed that the amino acid changes in the peptide due to functional polymorphisms or even deletions, result in heterogeneity of the major milk proteins,

summarising into αS1-CN (8), αS2-CN (4), β-CN (12), κ-CN (11), β-LG (11) and α-LA (3) variants. Breeders also wants to increasing the proportion of unsaturated fatty acids may be the target for selective breeding, even though the discussion of beneficial over unfavourable fatty acids relative to human health is complex. As per Stoop *et al.* (2008) [17] selection for fat percent will mainly increase C16:0. Generally the genetic correlations between C4:0 to C14:0 fatty acids are positive and high. But as per Krag *et al.* (2013) [12], Due to the negative correlation between groups of saturated and unsaturated fatty acids it may be possible to reduce the concentration of the less healthy saturated fatty acids and increase the concentration of unsaturated fatty acids. Association of genotypes with certain milk production traits revealed that AB had significant (p<0.05) effect on total milk yield, peak yield, yield at 300 days and SNF % as compared to AA. Deb *et al*. (2014) [16].

2. Material and Methods

From each of the above breed 100 ml samples are collected and then maintaining cold chain. Fat (%), Protein (%), Lactose (%), SNF (%) and Milk density (Kg/L) were determined by lactometer.

2.2 Blood Collection

Collected 5 ml blood sample in EDTA coated vacationer aseptically from 50 animals of each of the four breeds viz. Sahiwal, Malvi, Nimari and HF crossbred cattle then brought to the laboratory for maintaining cold chain and DNA isolation.

2.3 Genomic DNA isolation

As per John *et al*. (1991) [11] method with minor modifications, genomic DNA was extracted.

2.4 Sequencing

The sequences obtained from genotype were aligned using Clustal W. Aligned sequences were analyzed for group specific SNP marker and analyzed by using MEGA 6 software (Tamura *et al.*, 2004) [19].

2.5 Statistical analysis

Calculation of Gene and genotype frequencies: Gene and genotype frequencies were estimated using Popgene 32 (version 1.32), Microsoft Windows-based freeware for population genetic analysis (Yeh *et al*., 1999) [21].

2.5.1 Association of various polymorphic variants of milk composition traits

Correlation study of various polymorphic variants of milk protein genes with milk composition traits done by SPSS software.

3. Results and Discussion

3.1 Daily Milk yield (DMY): DMY showed that there was a positive and highly significant correlation with milk yield of both AA (0.38**) and AB (0.89**) genotype of αs2-casein gene in Nimari cow. As per some studies are suggested AA genotype as most favourable for animal selection (Alipanah *et al.*, 2008; Sitkowska *et al.*, 2008) [2, 3]. While others BB genotype was more associated with milk traits (Rachagani and Gupta, 2008) [18]. As per Pandey (2021) [1] Correlation study of DMY showed that there was a positive and highly significant correlation with milk yield of both AA (0.89**) and AB (0.84**) genotype of αs2-casein gene in Malvi cow. Lactation length showed negative and significant correlation with milk yield (MY) and daily milk yield (DMY) trait in AA genotypes. whereas AB genotypes showed non-significant but positive correlation with milk yield.

3.2 Lactation length (LL)

Lactation length showed Positive and significant correlation with milk yield (MY) 0.60** but significant and negative correlation with daily milk yield (DMY) -0.49** trait in AA genotypes. Whereas AB genotypes showed non-significant but negative correlation with milk yield (-0.09) and daily milk yield (-0.52**DMY) of Nimari cow.

Table 1: Correlations between the milk yield and milk composition traits for AA genotype of αS2-casein gene in Nimari

	MY	DMY	LL	Fat	Protein	Lactose	SNF
DMY	0.38**						
LL	0.60**	-0.49**					
Fat	-0.04	0.04	-0.11				
Protein	-0.12	-0.01	-0.13	0.07			
Lactose	-0.12	0.01	-0.14	0.17	0.99**		
SNF	-0.12	0.02	-0.17	0.56**	0.87**	0.91**	
Density	-0.12	-0.00	-0.13	0.04	0.99**	0.99**	0.85**

** (p<0.01), *(p<0.05)

Table 2: Correlations between the milk yield and milk composition traits for AB genotype of αs2- casein gene in Nimari

	MY	DMY	LL	Fat	Protein	Lactose	SNF
DMY	0.89**						
LL	-0.09	-0.52**					
Fat	-0.57**	-0.42**	-0.15				
Protein	0.10	0.01	-0.03	-0.36*			
Lactose	-0.06	-0.01	-0.16	0.06	0.08		
SNF	0.00	0.005	-0.02	0.36**	0.05	0.38*	
Density	-0.09	0.01	-0.23	0.12	0.50*	0.25	-0.09

** (p<0.01), *(p<0.05)

3.3 Fat

In AA genotype of Nimari cow, Fat % showed significant but negative correlation with milk yield (-0.04) and lactation length (-0.11) whereas in AB genotype Fat % also showed significantly negative correlation with both milk yield (-0.57**) daily milk yield trait (-0.42**) and Lactation length of Nimari cow (-0.15) Tab. 02. Milk yield and composition percentages are negatively correlated, -0.3 for milk yield and fat percentage (Gaunt, 1980) [9].

3.4 Protein

Milk protein of AA genotype showed non-significant and negative correlation with Milk yield (-0.12) Daily milk yield (-0.01) and Lactation length (-0.13) but non-significant and positively correlated0 (.07) with Fat % (0.07) (Tab.1).

whereas Significant but negative correlation noticed between milk protein of AB genotype of Nimari cow and Fat % (-0.36*) and remaining traits Milk yield and daily milk yield showed non-significant and positive correlation with Protein but non-significant value noticed between milk protein and lactation length (-0.03). (Gaunt, 1980) [9] Genetic and phenotypic correlations of casein yield with milk, fat, and protein yields were large and positive. Genetic correlation of casein percent with milk yield was negative (−.76) but positive (.96) with protein percent. A variant of β-LG has been repeatedly found to be associated with higher β-LG concentration (Ng-Kwai-Hang *et al.*, 1987; Heck *et al.*, 2009) [14, 10].

3.5 Lactose
Highly significant and positive correlation noticed between lactose and milk protein (0.99**) whereas lactose showed non – Significant but positive correlation with Milk yield (-0.12) and Daily Milk Yield (0.01). Lactation length (-0.14) and Fat % (0.17) of AA genotype of Nimari showed negative and positive correlation respectively with Lactose. Lactose of AB genotype of Nimari showed non-significant and negative correlation with milk yield (-0.06) daily milk yield (-0.01) and lactation length (-0.16). whereas Fat % (-0.06) and milk protein (0.08) showed non – Significant but positive correlated with lactose. As per Haile-Mariam *et al.* (2017) [13] the correlation between milk yield and lactose yield was close to 1 and high positive genetic correlation noticed between lactose yield and protein yield, the trait highly emphasized in Australia. As Davies *et al.* (2021) [5] per Increases in SCC and TBC are negatively associated with milk lactose content.

3.6 SNF
As per Tab. 01 of AA genotype of Nimari cow milk SNF showed non – Significant but negative correlation with Milk yield (-0.12) and lactation length (-0.17) whereas, Fat % (0.56**) Protein (0.87**) and lactose (0.91**) are showed highly significant and positive correlation with SNF.
SNF of AB genotype in Nimari breed cow showed Highly significant and positive correlation with Fat % (0.36**) and lactose (0.38*) whereas with rest trait SNF showed non-significant correlation. As per Deb *et al*. (2014) [16] association of genotypes with certain milk production traits revealed that AB had significant (p<0.05) effect on total milk yield, peak yield, yield at 300 days and SNF% as compared to AA.

3.7 Density
Highly significant and positive correlation noticed with milk protein, lactose and SNF whereas with remaining traits milk density showed non-significant correlation.
Milk density of AB genotype of Nimari cow showed significant and positive correlation with milk protein (0.50**) whereas with remaining traits showed non-significant correlation.

4. Conclusion
DMY showed that there was a positive and highly significant correlation with milk yield of both AA and AB genotype of αs2-casein gene in Malvi cow.
Lactation length showed negative and significant correlation with milk yield (MY) and daily milk yield (DMY) trait in AA genotypes. whereas AB genotypes showed non-significant but positive correlation with milk yield. Fat % showed highly significant negative correlation with milk yield and daily milk yield whereas in AB genotype Fat % also showed significantly negative correlation was noticed between Fat % and Lactation length of Malvi cow. Milk protein of AA genotype showed significantly negative correlation with milk Fat % whereas Significant but positive correlation noticed between milk protein of both AA and AB genotype of Malvi cow and milk yield. Lactose of AA and AB genotype of Malvi showed highly significant and positive correlation with milk yield and milk protein. SNF of AB genotype if Malvi showed Highly significant and positive correlation with lactosemilk protein and Milk yiel. Milk density of AB genotype of Malvi cow showed highly significant and positive correlation with milk protein Lactose and SNF.

5. References

1. Pandey A. Study the association between milk composition traits and different genetic variants of αS2 casein gene in Malvi cow of M.P., India. Bioved. 2021;31(1,2):9-13.
2. Alipanah M, Alexandrovna K, Rodionov G. Kappa-casein and PRL-RSAI genotypic frequencies in two Russian cattle breeds. Arch Zootecnia. 2008;57:131-138.
3. Sitkowska B, Neja W, Wiśniewska E. Relations between kappa-casein polymorphism (CSN3) and milk performance traits in heifer cows. J Cent Eur Agric. 2008;9:641-644.
4. Caroli AM, Chessa S, Erhardt GJ. Milk protein polymorphisms in cattle: effect on animal breeding and human nutrition. J Dairy Sci. 2009;92(11):5335-5352.
5. Davies DT, Holt C, Christie WW. The composition of milk. In: Biochemistry of Lactation, Mepham TB (ed.). Amsterdam: Elsevier; c1983.
6. Farrell HM Jr, Jimenez-Flores R, Bleck GT, Brown EM, Butler JE, Creamer LK, *et al*. Nomenclature of the proteins of cow's milk—sixth revision. J Dairy Sci. 2004;87(6):1641-1674.
7. German JB, Dillard CJ, Ward RE. Bioactive components in milk. Curr Opin Clin Nutr Metab Care. 2002;5(6):653-658.
8. Goddard ME, Hayes BJ. Mapping genes for complex traits in domestic animals and their use in breeding programmes. Nat Rev Genet. 2009;10(6):381-391.
9. Gaunt SN. Genetic variation in the yields and contents of milk constituents. Int Dairy Fed Bull. 1980;Doc 125:73.
10. Heck JML, Schennink A, Valenberg HJFV, Bovenhius H, Visker MHPW, Arendonk JAMV, *et al*. Effects of milk protein variants on the protein composition of bovine milk. J Dairy Sci. 2009;92:1192-1202.
11. John SW, Weitzner G, Rozen R, Scriver CR. A rapid procedure for extracting genomic DNA from leukocytes. Nucleic Acids Res. 1991;19(2):408.
12. Krag K, Poulsen NA, Larsen MK, Larsen LB, Janss LL, Buitenhuis B. Genetic parameters for milk fatty acids in Danish Holstein cattle based on SNP markers using a Bayesian approach. BMC Genet. 2013;14:79.
13. Haile-Mariam M, Pryce JE. Genetic parameters for lactose and its correlation with other milk production traits and fitness traits in pasture-based production systems. J Dairy Sci. 2017;100(5):3754-3766.
14. Ng-Kwai-Hang KF, Hayes JF, Moxley JE, Monardes HG. Relationships between milk protein polymorphisms and major milk constituents in Holstein Friesian cows. J Dairy Sci. 1986;69(1):22-26.
15. Ogorevc J, Kunej T, Razpet A, Dovc P. Database of cattle candidate genes and genetic markers for milk production and mastitis. Anim Genet. 2009;40(6):832-851.
16. Deb R, Singh U, Kumar S, Singh R, Sengar G, Sharma A. Genetic polymorphism and association of kappa-casein gene with milk production traits among Frieswal (HF× Sahiwal) crossbreed of Indian origin. Iran J Vet Res. 2014;15:406-408.
17. Stoop WM, Arendonk VJAM, Heck JML, Valenberg VHJF, Bovenhuis H. Genetic parameters for major milk fatty acids and milk production traits of Dutch Holstein-Friesians. J Dairy Sci. 2008;91(1):385-394.
18. Rachagani S, Gupta ID. Bovine kappa-casein gene polymorphism and its association with milk production traits. Genet Mol Biol. 2008;31:893-897.
19. Tamura K, Nei M, Kumar S. Prospects for inferring very large phylogenies by using the neighbor-joining method. Proc Natl Acad Sci U S A. 2004;101:11030-11035.

20. Thomas PC, Chamberlain DG. Manipulation of milk composition to meet market needs. In: Recent Advances in Animal Nutrition, Haresign W, Cole DJA (eds.). London: Butterworth; c1984.
21. Yeh FC, Yang RC, Boyle TBJ, Ye ZH, Mao JX. Popgene 32 version 1.32, the user-friendly shareware for population genetic analysis. Mol Biol Biotechnol Centre, Univ Alberta, Canada; c1999.