The Pharma Innovation Journal 2021; SP-10(5): 728-731

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(5): 728-731

www.thepharmajournal.com
Received: 17-03-2021
Accepted: 20-04-2021

Oshin
PhD Scholar, Animal Genetics & Breeding division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Sagar Kadyan
PhD Scholar, Department of Livestock Production Management, Lala Lajpat Rai university of Veterinary and animal Sciences, Hisar, Haryana, India

Nandhini PB
PhD Scholar, Animal Genetics & Breeding division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Sushil Kumar
Scientist, Krishi Vigyan Kendra, Jaora, Ratlam, Madhya Pradesh, India

Corresponding Author:
Oshin
PhD Scholar, Animal Genetics & Breeding division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Phenotypic relationship among udder type traits and milk production traits in Sahiwal cattle

Oshin, Sagar Kadyan, Nandhini PB and Sushil Kumar

Abstract
The study aimed to find the relationship among udder, teat type traits and milk production traits in Sahiwal cows. Hundred lactating cows from Livestock research farm in ICAR- NDRI, Karnal, India were chosen for the investigation. The value of the Pearson's linear correlation coefficient defined by the Greek alphabet rho (Γ) determined the level of relationship between the traits achieved using the correlation procedure (PROC Corr) (SAS). High positive correlation ($p < 0.05$, $p < 0.01$) was found between Udder Length & Udder Depth (0.99), Udder Length & Udder Balance (0.99), Udder Depth & Udder Balance (0.99) and Teat Length & Teat Circumference (0.529). Moderate yet significant values of correlation were there between Udder Length & Central Ligament (0.373), Udder Length & Average Distance between teats (0.373), Udder Length & Shortest distance from teat ends to floor (0.34), Rear Udder Height & Udder Balance (0.43), Udder Width & Udder Circumference (0.44), Lifetime Milk yield & 305 Days Milk yield (0.44) and low correlation between 305 Days Milk Yield & Udder Length (0.28), Udder Width (0.323). On the other hand, significant negative correlation between, Fore Udder Attachment & Rear Udder Height (-0.33), Udder Width & Central Ligament (-0.23), Teat Diameter & Udder Depth (- 0.248) and 305 Days Milk Yield & Udder Depth (-0.43) was observed. The indirect selection of Sahiwal cows based on the findings of the study will facilitate the process of decision-making in selection for improved udder confirmation traits and milk production in cows.

Keywords: Correlation, udder traits, teat traits, milk production traits, Sahiwal

Introduction
Udder type traits unquestionably play a crucial role in the selection and judgement of dairy animals since older times and have been conventionally included in dairy cattle selection schemes. Sometimes because of the unavailability of production records of animals, particularly in villages, it is always essential to have some idea about the production potential of animals which can be inferred from the udder confirmation. It was reported that Udder characteristics were important in relation to milk production where production records were lacking [1]. Local brokers or animal husbandry men in our country have considered the udder as the prime factor or first site for judging the milking ability of animals [2]. These traits are generally medium to high heritable and can be recorded early in life making the selection process relatively more efficient [3]. It is obvious that considering udder measurement scores and milk yields into an index result in a greater gain in milk yield than selection based only milk production records. The type and conformation traits appear to be more suitable than the detailed traits for predicting the lifetime production efficiency of cows [4]. The knowledge of the relationships between individual traits of udder morphology is important for their including into total selection indexes or for construction of partial selection indexes for udder morphology which enables to predict future correlated responses in milk-oriented selection schemes [5]. Besides milk production, calf survival, growth and cow longevity are also somewhere dependent on udder conformation traits. Numerous studies are there which have reported the relationship between body confirmation traits and milk yield in dairy cattle [6-8], however, studies of correlation among udder and teat type traits and milk production traits are lacking in Sahiwal cattle. Sahiwal cattle is one of the best dairy breeds of India. The genetic correlations between traits are needed for construction of selection index, which also demands large and well-structured data. Unfortunately, these pre-requisites have not been satisfied in the resource populations so far. Nevertheless, the present study was executed with the objectives to find out the correlation estimates for udder and teat biometrics and milk yield in Sahiwal cows which would be providing the preliminary foundation for the selection of udder traits bringing great benefits to improve milk production.

Material and methods

Experimental animals and location: 100 lactating Sahiwal cows reared in the Livestock research farm in ICAR- NDRI, Karnal, India were chosen randomly. The location of farm is between 29° 42'N latitude and 72° 54'E longitude at an altitude of 250 m above the mean sea level (MSL). Subtropical climate prevails with temperature ranging between 45°C to 2°C. The annual rainfall is 760 to 960 mm and relative humidity ranges from 40 to 85%. All nutrient requirements of lactating animals were fulfilled.

Parameters studied: Different types of records were needed for accomplishment of the present investigation. Few traits were recorded, and some were generated as follows. Traits recorded: a) Lifetime milk yield (kg) (LTMY), b) 305-days milk yield (kg) (305 DMY); Traits generated: The udder and teat type traits were scored linearly on possible score scale from one biological extreme to other. The measurements were recorded on each animal while it was standing evenly on its feet with utmost precision, 2 hours before evening milk. Measurement of nine udder traits viz. Fore udder attachment (FUA), Rear udder height (RUH), Udder depth (UD), Udder Balance (UB), Rear udder width (RUW), Central ligament (CL), Udder length (UL), Udder width (UW), Udder circumference (UC) and five teat type traits viz. Teat thickness (TT), Teat length (TL), Teat circumference (TC), Average Distance between teats (DBT), Average Shortest distance from teat ends to floor (DFF) was done according to the procedure followed by ICAR and WHFF [9,10]. Teat measurement were done with help of Vernier calliper and Metal tape (200 cm) was used for udder traits. The range for each trait was estimated by subtracting the minimum value with maximum. As the number of classes in which the animals were evaluated was 9, thus range was divided by 9 to get the unit score point. This unit score point was added to that of minimum value to get the range for score 1. The subsequent score classes were obtained by adding unit score point to the highest unit of previous classes.

Statistical analysis: The experimental design is a nested classification of a completely randomized design with the main treatment effect measured being the Udder and teat type traits and their milk production records (LTMY and 305 DMY). The simple Linear Correlation Procedure of SAS (version 8) [11] was used to establish the strength of linear relationship and association between the different measurements together with the milk production records using the model:

$$\Gamma = \Sigma x_i y_i / \sqrt{\Sigma x^2_i \, \Sigma y^2_i}$$

Where

Γ = Pearson's product moment correlation coefficient.

X_i = the first random variable of the i^{th} udder measurement value or milk production record.

Y_i =the second random variable of the i^{th} udder measurement value or milk production record

This was achieved using the correlation procedure (PROC Corr) (SAS Inst, 1999).

Result

The results of the correlation analysis are shown in Table 1, 2 and 3. High significant correlation was observed between UL & UD (0.99), UL & UB (0.99), UD & UB (0.99) and TL & TC (0.529). However, UL & CL (0.373), UL & DBT (0.373), UL & DF (0.34), RUH & UB (0.43), and UW & UC (0.44) were having moderate yet significant values of correlation. On the other hand, significant negative correlation between, FUA & RUH (-0.33), UW & CL (-0.23) and TD and UD (-0.248) was observed. A moderate correlation between LTMY and 305 DMY was seen which was highly significant (0.44). Significant but low correlation was observed between 305 DMY & UL (0.28), 305 DMY & UW (0.323) and a negative correlation between 305 DMY and UD (-0.43) was evident. Low values of correlation were seen between 305 DMY & TL (0.147), 305 DMY & CL (0.125), 305 DMY & RUW (0.32), 305 DMY & UD (0.19) and 305 DMY & UL (0.287), but non-significant.

Table 1: Correlation among udder type traits

	FUA	RUH	RUW	UL	UW	UC	UD	UB	CL
FUA	1	-0.33*	-0.05	0.153	0.01	0.26	0.109	-0.124	-0.032
RUH		1	0.265	0.03	0.045	0.02	0.10	0.43*	0.03
RUW			1	-0.126	0.03	0.25	-0.201	0.190	-0.065
UL				1	-0.001	0.099	0.999**	0.998**	0.373**
UW					1	0.44*	-0.02	0.001	-0.23*
UC						1	-0.052	0.133	-0.176
UD							1	0.999**	-0.188
UB								1	0.007
TL									0.100

* Correlation significant at $p<0.05$; ** Correlation significant at $p<0.01$

Table 2: Correlation among udder and teat type traits

	TL	TC	TD	DBT	DF
FUA	-0.019	0.049	0.104	-0.037	-0.006
RUH	0.08	0.004	0.075	0.043	0.01
RUW	-0.172	-0.076	-0.027	-0.028	-0.127
UL	-0.165	-0.221	0.022	0.373**	0.340**
UW	0.07	0.002	0.01	0.125	0.011
UC	-0.176	-0.022	0.003	0.128	0.009
UD	-0.045	0.94	-0.248*	-0.184	-0.167
UB	-0.289	-0.104	0.135	0.015	000
TL	1	0.529**	-0.084	-0.119	0.074
CL		-0.022	0.003	0.128	0.010
TC		1	0.107	-0.204	0.145
TD			1	-0.067	0.071
DBT				1	0.009

* Correlation significant at $p<0.05$; ** Correlation significant at $p<0.01$

Table 3: Correlation between udder and teat type traits and milk production traits

	MY	LMY
FUA	-0.042	-0.101
RUH	0.002	0.009
RUW	0.001	-0.006
UL	0.287*	-0.142
UW	0.323*	0.23
UC	0.082	-0.022
UD	-0.43*	0.079
UB	0.018	0.090
TL	0.147	0.038
CL	0.125	-0.043
TC	-0.004	0.35
TD	0.043	-0.034
DBT	0.065	-0.011
DF	-0.034	-0.023
MY	1	0.445**

* Correlation significant at $p<0.05$; ** Correlation significant at $p<0.01$

Discussion

A positive correlation was found between UL and UD, UL and UB, UL and CL, UL and DBT, UL and DFF which implies that there is very strong tendency that drastic change will occur in UD and UB, and moderate change in CL, DBT, DFF, if any change occurs in UL. If animal had long udder, it would have a strong chance of having shallower udder with more distance between teats, teats will be longer so that DFF is less with deeper crease between udder halves and a more balanced udder than other animals. This is very near to an ideal udder confirmation, which could be due to selection of improved udder traits from previous generations in the resource population. The results are in accordance with findings of [12] who has reported a significant correlation of UL with DBT. Same was reported by [13] while working on Kankrej and crossbred cows. [2] found highly significant ($p<0.01$) and positive correlations among the udder measurements viz., udder length and udder depth. Similarly, [14,15] found the correlation between udder measurements in Gir cows while it was observed in Jersey × Kankrej F1 cows by [16] and in Sahiwal cows by [17]. Cows with shallower udders showed a very strong tendency to exhibit more ideally balanced udders than the cows with deeper udders as indicated by the results of present investigation. Similarly, the results show that cows with longer teats were strongly oriented to have large teat circumference which might be due their genetic predisposition. Results resemble the findings of [18] who stated the same. TL and TD were positively correlated genetically and phenotypically and thus heifers with longer teats have larger teat diameter [14]. Also reported Significant ($p<0.05$) correlation between the teat length and teat diameter. Furthermore, RUH being correlated with UB implied that cows having higher rear udders had a strong chance of having more balanced udder than the other cows. The reason behind this must be that cows having higher rear udders will have less tendency to loosen their rear udders subsequently resulting in well balanced udder. Cows with more UW showed a trend of having higher UC which is very obvious, and both contribute to higher udder capacity. However, FUA & RUH, UW & CL and TD & UD were inversely related to each other. There was a tendency for cows with higher udders to have weak fore udder attachments as reported by [5]. This might be because of higher pressure on the udder tissue in high producers [19]. Found a negative correlation between these characteristics, suggesting that weak attachments are genetically related to pendulous, deep udders while working in Latxa breed. A tendency of cows with wider udder to have smaller udder clefts was also observed which has not been reported in any previous study. It was also observed that teat diameters were bigger for those animals which had deeper udders which might be at some specific stage of lactation when the production is high, udder tissue gets loosened, and diameter of teats are also visibly big because of increased pressure of milk in it. 305 DMY proved to be an obvious indicator of LTMY with a very significant correlation between both. Correlation of 305 DMY with UW, UL and UD showed that cows with wider udders and with longer UL had the pronounced tendency to have high 305 DMY than the rest. Higher values UL and UW make the udder bigger which is an obvious indicator of higher milk production, however negative correlation with UD was seen. According to the scale of measurement used in the study, higher values of UD indicate more shallower and less suspended udder. It appears that high producing heifers are expected to have lower udder height from the ground to the base of the teats. The antagonistic relationship between lactational performance and udder depth indicates the difficulty in selecting high producing cattle with well-suspended udders [18]. Results of the present investigation resemble with report of [20] who found significant correlation ($p<0.05$) between milk yield and UL, UW and UD. [21,2] also reported the significant correlations between milk yield and various udder measurements viz., udder depth, udder length, udder width in crossbred cows and buffaloes and further established that these three should be an important criterion for selection of dairy cows as the udder length, width and depth decides the capacity of udder [22] found weak phenotypic correlations between udder traits and milk production traits and his results were in accordance with our study as correlation between udder depth and 305 DMY was -0.20. [18] established that cows with high milk yield had deep udders, consistent with results from literature on earlier data. [23] concluded that among udder conformation, udder depth and length were the most correlated to milk production. [24] also found a positive and significant ($p<0.01$) association between udder length, width, and depth with test day milk yield in Jersey × Red Sindhi crossbred cows. [25, 26] also noticed a strong correlation of milk yield with udder length, width, and depth in Holdeo crossbred cows and Kenana × Friesian crossbred cows, respectively. Same was reported by [20] in Vrindavani cattle. However, no significant correlation was found between teat type traits and milk yield in the present study similar to the findings of [2] where all the teat measurements showed a non-significant relation with milk yield. [27] also had the similar observation that correlation coefficient of teat length and diameter with milk production were not conclusive while working on Karan-Fries cows.

Conclusion

The results of the present investigation show the relationship among the different udder and teat type measurements and milk production records of Sahiwal cows. Considering the correlation of the different traits appropriately in a breeding scheme will accurately evaluate the animals. The udder biometry as an indicator of size, may be beneficial as an additional trait to improve response to selection for milk yield. Therefore, the apprehension of the connection between morphological udder traits would permit to project future correlated responses in milk-oriented selection schemes.

Acknowledgement
Facilities provided by Director, Indian Council of Agricultural Research-National Dairy Research Institute, Karnal, India to conduct this research is duly acknowledged. Any specific funding was not received.

References

1. Akhtar N, Thakuria K. Milk production in relation to variation in size and shape of udder in Swamp buffaloes. Indian J. Anim. Sci 1998;68:1281-1283.
2. Patel YG, Trivedi MM, Rajpura RM, Savaliya FP, Monika P. Udder and teat measurements and their relation with milk production in crossbred cows. Int. J. Environ. Sci. Technol 2016;*5*(5):3048-3054.
3. Dechow, Chad D. Body Condition Score and Dairy Form as Indicators of Dairy Cattle Disease and Reproductive Performance. PhD dissertation. University of Tennessee, Dechow, C.D 2003.
4. Sawa A, Bogucki M, Krężel-Czopek S, Neja W. Relationship between conformation traits and lifetime production efficiency of cows. ISRN vet. sci 2013.
5. Milerski M, Margetín M, Capistrak A, Apolen D, Spanik J, Oravcová M. Relationships between external and internal udder measurements and the linear scores for udder morphology traits in dairy sheep. Czech J of Ani. Sci 2006;51(9):383.
6. Boelling D, Madsen P, Jensen J. Genetic Parameters of Foot and Leg Traits in Future AI Bulls: II. Correlation to Body Conformation Traits in Daughters. Acta Agri. Scandinavica, Section A-Ani. Sci 2001;51(2):122-128.
7. DeGroot BJ, Keown JF, Van Vleck LD, Marotz E. Genetic parameters and responses of linear type, yield traits, and somatic cell scores to divergent selection for predicted transmitting ability for type in Holsteins. J. Dairy Sci 2002;85(6):1578-1585.
8. Wiggans GR, Gengler N, Wright JR. Type trait (co)variance components for five dairy breeds. J. Dairy Sci 2004;87(7):2324-2330.
9. ICAR. International agreement of recording practices. Guidelines approved by the general assembly, Riga, Latvia, June 2010. International Committee for Animal Recording, Rome, Italy 2012.
10. WHFF. Documentation. Type harmonization. World Holstein Friesian Federation 2012.
11. SAS. SAS Users Guide: Statistics released version 8.0. Statistical Analysis System Institute. Inc., Cary, NC, 1999.
12. Raju B. Studies on the influence of udder and teat morphology on milk flow traits and milk yield in jaffarabadi buffaloes. PhD dissertation, PVNR Telangana Veterinary University, Hyderabad 2017.
13. Kshatriya PS, Trivedi MM, Dhami AJ. Association of Udder Biometry and Skin Thickness with Milk Yield in Kankrej and Crossbred Cows. Indian J. Field Vet 2009;5(1):11-13.
14. Tripathi GS, Koul GL, Katpatal BG. Biometrical studies on shape and size of udder and teats and their relation with milk yield in Gir cattle. Indian J. Dairy Sci 1982;35:539-54.
15. Singhai SK, Ravikala K, Murthy KS, Gajbhiye PU, Vataliya PH, Savsani HH. Udder teat morphology and body measurements and their relationship with milk yield and milking traits in Gir cows. Indian J. of Ani. Prod. and Mngmt 2013;29(1, 2):5-11.
16. Saiyed LH. Biometrics of certain body parts in relation to body weight and milk production in Jersey × Kankrej crossbreds. M. V. Sc. Thesis. Gujarat Agricultural University, Anand 1987.
17. Ahlawat, Kuldeep, Dang AK, Singh, Charan. Relationship of teat and udder shape with milk SCC in primiparous and multiparous Sahiwal cows. Indian J. D. Sci 2008;61(2):152-156.
18. Norman HD, Powell RL, Wright JR, Cassell B. Phenotypic and genetic relationship between linear type traits and milk yield for five breeds. J. Dairy Sci 1988;71(7):1880-1896.
19. Legarra A, Ugarte E. Genetic parameters of udder traits, somatic cell score, and milk yield in Latxa sheep. J. of D. Sci 2005;88(6):2238-2245.
20. Singh, Rana Ranjeet, Dutt Triveni, Singh, Mukesh, Amit Kumar. Association of udder and teat dimensions with production traits in Vrindavani cattle. Indian J D. Sci., 2010;63(6):455-458.
21. Khatri SB, Trivedi MM, Patel YG, Rajpura RM. Udder and Teat. Measurements and their Relation with Milk Production. International J. Adv. Biotech Res. 2017;7(3):582-584.
22. Liu SB, Yi JM, Yan BF, Fu HH, Zhang JW, Wang TT *et al*. Correlations analysis among udder traits, final score and milk production traits in Chinese Holstein dairy cows. China J Anim Sci 2010;21:5
23. Ángeles Pérez-Cabal M, Legaz E, Cervantes I, Martínez R, Goyache F, Gutiérrez JP. Association between body and udder morphological traits and dairy performance in Spanish Assaf sheep. Archives Animal Breeding 2013;56(1):430-442.
24. Ghosh B, Prasad J. Milk yield and composition as influenced by udder measurements in Jersey x Red Sindhi crosses. Indian J. of Ani. Prod. and Mngmt 1998;14:23-25.
25. Waghmore, Prashant, Siddiqui MF. Studies on correlation of different udder and teat measurements with lactation milk yield in case of Holde crossbred cows. Karnataka J. of Agri. Sci 2000;13(3):802-804.
26. Deng MP, Badri TM, Atta M, Hamad ME. Relationship between udder dimensions and milk yield of Kenana × Friesian crossbred cows. Res. Opinions in Ani. & Vet. Science 2012;2(1):49-54.
27. Gupta R, Singh RP, Tomar SS. Udder and Teat measurement and their association with milk production in Karan-Fries cows. Indian J. Ani. Rese 1991;25(1):23-28.