GENETIC PARAMETERS OF LACTATION MILK YIELD AS AFFECTED BY LACTATION LENGTH ADJUSTMENT PROCEDURES

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INTRODUCTION

Most of the Sahiwal cattle (80%) do not produce milk for a standard duration of 305 days (Dahlin, 1998). Shorter lactations are either deleted from the data set or are used irrespective of duration (considering them the genetic potential of the animal) or can be adjusted. Contradictory views are available in the literature as to which lactation should be declared short. Assumption that yield from a shorter lactation should be considered as the genetic potential of the cow (Syrsted, 1993) is difficult to justify especially when reasons for a lactation to be short are rarely recorded; genetic control of lactation length is weak and because statistical procedures can be developed which can yield very precise adjustments even if the animal dried (Norman *et al*., 1985) or if information on the reason of drying was not clear/recorded. Limited resources further necessitate that every recorded lactation, short or long, should be best utilized. Present study was planned to see how best lactation length could be adjusted so that shorter lactations could be utilized without sacrificing genetic variation.

MATERIALS AND METHODS

Weekly milk yield and pedigree records of Sahiwal cows having minimum lactation length of 8 weeks (n=2039) and calving between 1990 and 2000 were used in the present study. Milk yield was truncated at 44 weeks. Three adjustment methods were compared. A regression equation was developed for predicting 308-day yield (kg) from lactation length (days) and multiplicative adjustment factors were then developed. This procedure is being used at present. The adjusted lactation yield variable was named as MYLR. In the second method, last test day milk yield information (last recorded milk yield available for any lactation) was used to predict future daily milk yield for unrecorded lactation period and 308 day yield was then estimated. The 308-day adjusted milk yield variable was named as MYLTD. The third method was similar to the second one but average daily milk yield was added as predictor of future daily milk yield (Khan *et al*., 2000). The 308-day adjusted milk yield variable was then named as MYLTAD. For heritability and repeatability estimation of unadjusted milk yield (UNAMY) and adjusted milk yields as described above a repeatability animal model was used. It included year by season of calving effect, animal (random) and permanent environment effects (random) and linear and quadratic effects of age at calving. DFREML (Meyer, 1997) computer program was used for this purpose.

RESULTS AND DISCUSSION

Out of 2039 lactation, only 30% had a standard lactation length, 57% were shorter than 280 days while 20% lactations were shorter than 180 days. Average milk yield varied with lactation length. Overall average lactation milk yield was 1475±651 kg. Lactation length averaged 247.6±66.7 days. Very short lactations (56-77 days) had average yield of 322 kg as compared to an average of 1999 kg when lactation length was 308 days (Table 1).

Table 1. Mean milk yield for different lactation length classes

Lactation length			Milk yield adjusted for lactation length		
(weeks)	N	UNAMY[1]	MYLR[2]	MYLTD[3]	MYLTAD[4]
8-11	53	322.5±139.47	3415.9±823.71	1377.1±377.34	1499.6±370.02
16-19	75	565.0±252.75	1951.7±782.33	1282.6±441.62	1375.4±463.35
24-27	115	863.4±232.28	1697.5±466.82	1325.8±293.62	1424.3±308.71
32-35	239	1409.2±413.27	1926.4±560.21	1664.3±424.55	1726.4±441.04
40-43	262	1808.2±489.17	1908.6±516.54	1853.3±490.87	1860.2±493.25
≥44	617	1999.0±474.49	1999.0±474.49	1999.0±474.49	1999.0±474.49
Overall	2039	1475.2±650.75	1973.0±605.88	1709.2±496.05	1753.3±483.87

[1] Unadjusted milk yield
[2] Milk yield adjusted by linear regression procedure
[3] Milk yield adjusted by last test day procedure
[4] Milk yield adjusted by using last test day yield and average daily milk yield of the known lactation length.

Comparison of Adjustment Procedures. The adjusted milk yields using linear regression procedure (MYLR) were very high due to negative intercept. The predicted milk yield for any lactation was thus restricted to be 4000 kg at the maximum. The unrealistic linear increase in milk yield for longer lactations predicted very high yields consequently overestimating the adjusted 308-day yield. In the other two methods intercept generally decreased as the lactation length increased while regression coefficient of future daily yield on last test day yield increased. When average daily yield was added as a predictor of the future daily yield the extent of increase or decrease was comparatively less pronounced. R^2 ranged from 30 to 65% and improved by about 8% when average daily yield of the recorded lactation was added as the predictor along with the last test day yield.

The linear regression procedure over adjusted shorter lactations (Table 1). The variation of the adjusted yields (MYLR) was also inflated (SD was 606 kg). If adjusted yields in this procedure were not restricted to 4000 kg, inflation would have been much higher. The extended yields were higher than the actual yield due to a higher base. Differences between MYLTD and MYLTAD were minor (Table 1).

On the basis of correlation between actual and predicted milk yields and standard deviation of bias (predicted minus actual yield) the difference between the two procedures that used last test day information was insignificant. The bias narrowed down and variation of bias also decreased with increase in lactation length. Standard deviation of bias was always higher for linear regression method. Standard deviation of bias was smaller when average daily yield was included as a predictor along with the last test day yield (MYLTAD) as compared to MYLTD where only last test day information was used to predict the future average daily yield. The correlation between predicted and actual milk yield under the three adjustment procedures also had the similar trend. These findings are in line with the earlier work on buffaloes (Khan *et al*., 2000) where it was suggested that last test day information and average daily yield of the recorded lactation be used for estimating the credit for the unknown lactation.

Heritability and repeatability estimates of milk yield. For the unadjusted milk yield phenotypic variance was 320771 kg^2 which reduced (by 38%) to 198624 kg^2 for MYLTAD (Table 2). For milk yield adjusted using linear regression (MYLR), reduction in phenotypic variance was 13%. The additive variances however, did not reduce at the same rate. Reduction for MYLTAD was 17% while for MYLR reduction was 24%. For permanent environmental variance reduction in MYLTAD, MYLTD and MYLR was 38, 34 and 49%, respectively.

Table 2. Estimates of variances and genetic parameters for milk yield

		Milk yield adjusted for lactation length		
Parameter	UNAMY[1]	MYLR[2]	MYLTD[3]	MYLTAD[4]
Additive σ^2	48514.78	36701.70	39993.47	40412.91
Permanent environment σ^2	100309.59	51370.38	65790.11	62643.82
Error σ^2	171947.11	191179.54	100461.96	95567.35
Phenotypic σ^2	320771.48	279251.63	206245.54	198624.08
Heritability	*0.15±0.042*	*0.13±0.037*	*0.19±0.045*	*0.20±0.041*
Repeatability	0.46±0.041	0.32±0.035	0.51±0.043	0.52±0.041

[1] Unadjusted milk yield
[2] Milk yield adjusted by linear regression procedure
[3] Milk yield adjusted by last test day procedure
[4] Milk yield adjusted by using last test day yield and average daily milk yield of the known lactation length

Heritability estimates for MYLTAD was better as compared to unadjusted yield (Table 2). Estimate for MYLTD was similar to that of MYLTAD (i.e. 0.19±0.045) while estimate for MYLR was the lowest (0.13±0.037). The repeatability estimates had the similar trend. Better estimates were obtained for MYLTD and MYLATD (0.51 to 0.52) as compared to MYLR (0.32). These estimates are in conformity to the estimates in literature. Heritability of milk yield reported for Sahiwal cattle by Talbott (1994)) was 0.18 for this herd while estimates was 0.17±0.3 as reported by Dahlin (1998). Ahmad (1999) recently reported milk yield to have heritability of 0.19±0.06. Repeatability estimates in the present study were towards higher side as compared with previous studies (Talbott, 1994 ; Ahmad, 1999) for Sahiwal cattle (0.30-0.32) in Pakistan.

Genetic parameters of milk yield varied when records were adjusted for lactation length or not. Some of the previous studies (Syrsted, 1993) indicated that the lactation length adjustment in zebu cattle was not needed. Selection for lactation length was argued as an indirect trait for milk yield assuming that genetic correlation between the two traits would be unity. Madalena *et al*. (1992) also had a similar argument for crossbred cattle. They suggested not to extend shorter lactations for selection of crossbred cattle in Brazil. It was argued that shorter lactations should be considered as the genetic potential of the animals and extending records for lactation length would hamper the selection schemes aiming to select for higher milk yield.

The adjustment procedure in most of the studies are in favour of either leaving records as such (unadjusted) or excluding records of shorter duration, as if relative proportion of genetic variance would reduce (Madalena *et al*., 1992 ; Metry *et al.*, 1994). Present study on the other hand indicated that if adjustments were made using last test day information alone or in combination with average daily yield information of the recorded duration, genetic parameters did not deteriorate. The present study supported the earlier work on Nili-Ravi buffaloes (Khan *et al*., 2000) that adjusting records by last test day procedure using the average daily yield of the recorded duration would improve the genetic parameters. This may allow the utilization of records which were shorter but preciously collected.

CONCLUSION

Most Sahiwal cows (70%) had a shorter lactation length than the ideal of 10 months. Adjustment of lactation length by simple linear regression procedure, currently in vogue, was the worst in terms of average and variance of bias (estimated minus actual yield) and correlation between actual and predicted yield as compared to procedures that used last test day information. Genetic parameters of milk yield were also lower when adjustment was made using this procedure. Best way to adjust for lactation length was to predict future daily yield by using last test day yield and average yield of the recorded duration and then estimate the standard lactation yield. Milk yield records should be adjusted by using this procedure in future.

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