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Estimation of factors for standardizing lactation yield to mature equivalent basis and factors affecting 305 day mature equivalent milk yield in Frieswal cattle

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Frieswal cattle is one of the crossbred cattle of India with 5/8 Holstein Friesian and 3/8 Sahiwal blood, developed by Central Institute for Research on Cattle (Formerly Project Directorate on Cattle), Meerut, India in collaboration with Ministry of Defence. The genetic evaluation in dairy cattle in India is mainly focused on projected or actual 305 day milk production. But the age factor is not generally considered in these evaluation systems. Adjustment factors to mature age for milk yield were estimated by Martinez *et al*. (1990) and Cilek and Tekin (2006a) in Holstein and Brown Swiss cows, respectively. Further, it is a common physiological phenomenon that milk yield increases with age until maturity and then declines slowly. Therefore, if it is asked to compare the genetic merit of cows at different ages, milk yield must be standardized according to their ages. In this study, it was aimed to calculate the adjustment factors for standardizing lactations to mature age for the Frieswal cattle reared in various Military Farms in India. The present study was also planned to assess the effects of non-genetic factors on the 305 day mature equivalent milk yield in Frieswal cows.

Lactation records (1987–2013) obtained from various Military farms were used in the study. In order to calculate the adjustment factors to mature age, polynomial regression method was used on 29,427 lactation records, classified into 127 monthly age groups from 24th to 150th month in Statistical Analysis System for Windows (SAS Version 9.3; SAS Institute, Inc., Cary, NC, 2001). Further, the mature equivalent 305 day milk yield was predicted for each animal in different parities. Least squares analysis of variance (Harvey 1990) was used to study the influence of season, year of calving and farm on ME-305 day milk yield. Each year of calving was divided into four seasons i.e. winter (December to March), summer (April to June), rainy (July to September) and autumn (Post monsoon) (October to November) based on climatological conditions. Period of calving was classified into five groups (1990 – 1995, 1996–2000, 2001–05, 2006–10 and 2011–15).The following model was used to analyze the effects of non-genetic factors on lactation traits of Frieswal cattle.

$$Y_{ijklm} = \mu + F_i + S_j + P_k + e_{ijklm}$$

where, Y_{ijkl}th, record of animal in the ith farm, jthseason and from kth period and lth parity; μ, overall mean; F_i, effect of ithfarm; S_j, effect of jth season of calving; P_k, effect of kth period of calving; e_{ijklm}, random error, assumed to be NID (0, σ^2_e).

Duncan's multiple range test (DMRT) modified by Kramer (1957) was used to make pair-wise comparison among the means.

For obtaining the adjustment factors to mature age, the prediction equation was determined as

$$\text{Milk yield} = 1854.432 + 41.505X - 0.243X^2$$

where X is the age in months.

The highest expected milk yield obtained was between 77 and 94 months of age. This milk yield (3,626 kg) was accepted as mature equivalent milk yield, which divided milk yield of other monthly age groups to obtain adjustment factors for mature age. The monthly age groups, expected milk yield and adjustment factors for mature age are presented in Table1. The adjustment factors of milk yield to mature age for 24th, 50th, 75th, 100th, 125th, 150th months were 1.34, 1.09, 1.01, 1.01, 1.12 and 1.39, respectively. This means that milk yield of the youngest cattle (calving in 24th month) will be multiplied by 1.34 whereas the milk yield of the oldest cattle (calving in 150th month) will be multiplied by 1.39 to estimate the mature equivalent milk yield. The trend of multiplying factors was as obviously expected, as it diminished gradually from the youngest age to mature age, and then slowly increased (Cilek and Tekin 2006b and Habib *et al.* 2012) which agrees with the trend in this study. In the present study, the multiplying factors were highest in cows aged above 148 month and the smallest at mature age (72–94 months). The mature age in Holstein cows were reported at 72–77 months in Holstein cows (Van

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Table1. Adjustment factors to mature milk yield of Frieswal cattle

Month	Expected MY (kg)	Adjustment factor	Month	Expected MY (kg)	Adjustment factor	Month	Expected MY (kg)	Adjustment factor	Month	Expected MY (kg)	Adjustment factor
24	2711	1.34	59	3457	1.05	94	3609	1.00	129	3165	1.15
25	2740	1.32	60	3470	1.04	95	3604	1.01	130	3143	1.15
26	2769	1.31	61	3482	1.04	96	3599	1.01	131	3121	1.16
27	2798	1.30	62	3494	1.04	97	3594	1.01	132	3099	1.17
28	2826	1.28	63	3505	1.03	98	3588	1.01	133	3076	1.18
29	2854	1.27	64	3515	1.03	99	3582	1.01	134	3053	1.19
30	2881	1.26	65	3526	1.03	100	3575	1.01	135	3029	1.20
31	2908	1.25	66	3535	1.03	101	3568	1.02	136	3005	1.21
32	2934	1.24	67	3544	1.02	102	3560	1.02	137	2980	1.22
33	2959	1.23	68	3553	1.02	103	3551	1.02	138	2954	1.23
34	2985	1.21	69	3561	1.02	104	3543	1.02	139	2929	1.24
35	3009	1.20	70	3569	1.02	105	3533	1.03	140	2902	1.25
36	3034	1.20	71	3576	1.01	106	3524	1.03	141	2876	1.26
37	3057	1.19	72	3583	1.01	107	3513	1.03	142	2848	1.27
38	3081	1.18	73	3589	1.01	108	3503	1.04	143	2821	1.29
39	3104	1.17	74	3595	1.01	109	3491	1.04	144	2792	1.30
40	3126	1.16	75	3600	1.01	110	3480	1.04	145	2764	1.31
41	3148	1.15	76	3605	1.01	111	3467	1.05	146	2734	1.33
42	3169	1.14	77	3610	1.00	112	3455	1.05	147	2705	1.34
43	3190	1.14	78	3613	1.00	113	3442	1.05	148	2675	1.36
44	3210	1.13	79	3617	1.00	114	3428	1.06	149	2644	1.37
45	3230	1.12	80	3620	1.00	115	3414	1.06	150	2613	1.39
46	3249	1.12	81	3622	1.00	116	3399	1.07			
47	3268	1.11	82	3624	1.00	117	3384	1.07			
48	3287	1.10	83	3625	1.00	118	3368	1.08			
49	3305	1.10	84	3626	1.00	119	3352	1.08			
50	3322	1.09	85	3627	1.00	120	3336	1.09			
51	3339	1.09	86	3627	1.00	121	3319	1.09			
52	3356	1.08	87	3626	1.00	122	3301	1.10			
53	3372	1.08	88	3625	1.00	123	3283	1.10			
54	3387	1.07	89	3624	1.00	124	3265	1.11			
55	3402	1.07	90	3622	1.00	125	3246	1.12			
56	3417	1.06	91	3619	1.00	126	3226	1.12			
57	3431	1.06	92	3616	1.00	127	3206	1.13			
58	3444	1.05	93	3613	1.00	128	3186	1.14			

Vleck and Henderson 1961) which coincided with Frieswal cattle in this study. The breed difference existed in the mature age of animals as mature age yield was found at about 104–108 months of age for Simmental cows in Turkey (Cilek and Tekin 2006b) which differed from this study and is much higher than Frieswal cattle.

The least square analysis was carried out to identify the effect of non-genetic factors, viz. period and season of calving, farm and regression on AFC on mature equivalent 305 day milk yield. The overall least squares mean of 305 day mature equivalent milk yield was 3590.89±12.19 kg. The least squares means along with standard errors for different factors are presented in Table 2. The farm, parity, season and period of calving had significant effect on 305 day mature equivalent milk yield. Military farm Kanpur (4252.12±58.71 kg) had highest 305 day milk yield followed by Military Farm Mhow (4247.34±49.42 kg) and Luknow (4158.86±26.07 kg). Better feeding and managemental practices available may be the reason for increased production in these Military Farms. Among all the Military Farms, MFs at Panagarh, Misamari and Jalandhar had the worst performance in terms of 305 day mature equivalent milk yield.

Animals calving in winter produced significantly higher milk yield (3667.49±14.21 kg) followed by autumn (3648.66±17.05 kg) and summer (3534.11±15.95 kg) calvers. The better performance of winter and autumn calvers may be due to availability of good quality feed, environment and management during the peak production period. These factors will help the animals to respond well by expressing better production potentiality. Heat stress also may be one of the reasons for the declined performance of the summer calvers. Animals calved during the period 2001–05 had significantly higher milk yield (3782.05±13.42 kg) followed by period 2011–15 (3704.50±15.06 kg). The performance of the animals during the initial period was lowest (3389.81±40.53 kg), indicating the positive genetic trend of milk production over years. The significant effects

Table 2. Least squares means of 305 day mature equivalent milk yield in Frieswal cattle

Factor	No.	305 day mature equivalent MY (kg)	Factor	No.	305 day mature equivalent MY (kg)
Overall Mean	28,877	3590.89±12.19	Dimapur	87	3483.21±102.03
Farm		**	Dagshai	181	3867.47±70.96
Meerut	4,282	3716.37±14.92	Karu	142	3674.52±80.07
Lucknow	1,502	4158.86±26.07	Binaguri	149	3170.91±78.55
Ambala	2,193	3595.60±22.03	Nowshera	564	3532.16±40.56
Jabalpur	1,448	3728.96±26.53	Srinagar	230	3319.27±63.64
Dehradun	598	3472.34±39.51	Kanpur	266	4252.12±58.71
Ahmednagar	762	3328.60±35.61	Yol	108	3526.83±91.58
Jhansi	431	3852.09±46.49	Panitola	125	3472.18±85.04
Jalandhar	3,289	3112.84±18.78	Udhampur	168	3787.97±73.69
Allahabad	238	4127.65±62.18	Gwalior	77	3486.18±108.47
Mhow	379	4247.34±49.42	Rajouri	139	3790.64±81.06
Bareilly	666	3502.14±37.87	Misamari	216	3111.46±65.32
Namkum	572	3447.70±40.78	*Season of calving*	**	
Panagarh	156	2861.00±76.55	Winter	10653	3667.49±14.21
Pimpri	2,446	3550.09±21.33	Summer	6331	3534.11±15.95
Belgaum	786	3516.51±34.80	Rainy	6711	3513.32±15.78
Secundrabad	1,093	3690.07±30.03	Autumn	5182	3648.66±17.05
Deolali	757	3678.37±35.41	*Period of calving*	**	
Agra	400	3845.58±48.14	1990-95	634	3389.81±40.53
Guwahati	376	3621.90±49.49	1996-2000	4116	3544.62±16.80
Bengdubi	1,110	3461.01±29.85	2001-05	7471	3782.05±13.42
Ferozpur	946	3178.89±32.19	2006-10	9950	3533.49±12.82
Jammu	963	3665.32±31.86	2011-15	6706	3704.50±15.06
Pathankot	1,032	3438.05±30.71	Regression on AFC	**	-0.30±0 .04

**P<0.01.

of period of calving (Gaur *et al.* 2008, Komatwar *et al.* 2010, Kumar *et al.* 2015) and season of calving (Gaur 2007, Kumar *et al.* 2015) on milk yield were reported in previous studies.

SUMMARY

Data pertaining to 29,427 lactation records of Frieswal cows maintained at various Military Farms from 1987 to 2015 were used in the study. A prediction equation was developed for the first time for calculating the adjustment factors to mature age and various adjustment factors were calculated based on age in months. In the present study, the mature equivalent age of Frieswal cows were calculated as between 77 and 94 months of age, as the highest milk yield was produced during this age group. Results of the study also clearly indicate that the non-genetic factors like farm, season and period of calving had significant effect on the 305 day mature equivalent milk yield. So the proper management interventions should be followed to improve the performance of Frieswal cows in Military Farms.

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REFERENCES

Cilek S and Tekin M E. 2006a. Estimation of factors for standardizing lactation yield to mature equivalent and 305–day basis for Brown Swiss cattle reared at Ulas State Farm. *Indian Journal of Animal Sciences* **76**(9): 621–24.

Cilek S and Tekin M E. 2006b. Calculation of adjustment factors for standardizing lactations to mature age and 305-day and estimation of heritability and repeatability of standardized milk yield of simmental cattle reared on Kazova state farm. *Turkish Journal of Veterinary and Animal Sciences* **30**: 283–89.

Gaur G K, Kumar A, Beniwal B K and Praveen. 2008. Evaluation of Frieswal bulls under farm and field conditions. *Indian Journal of Animal Sciences* **78**: 218–21.

Gaur G K. 2007. Environmental factors affecting various performance traits of Holstein Friesian × Sahiwal Cattle. *Indian Journal of Dairy Science* **54**: 209 –13.

Habib M A, Bhuiyan A K F H and Amin M R. 2012. Adoption of ratio factors for extending part lactation milk records for Red

Chittagong cattle in Bangladesh. *IRJALS* **1**(3): 56 – 63.

Harvey W R. 1990. *User's Guide for LSMLMW and MIXMDL PC-2 Version. Mixed Model Least-Squares and Maximum Likelihood Computer Program*. Ohio State University, Columbus, USA.

Komatwar S J, Deshpande A D, Kulkarni M D, Kulkarni A P, Yadau G B, Ulemale A H and Shisode M G. 2010. Study on the production traits in Holstein Friesian × Sahiwal crossbreds. *Indian Journal of Animal Production and Management* **26**: 177–81.

Kramer C Y. 1957. Extension of multiple range tests to group correlated adjusted means. *Biometrics* **13**: 13–18.

Kumar S, Alex R, Singh U, Kumar A and Das A K. 2015. Comparative performance evaluation of Frieswal bulls in organized farms and farmers' herds. *Indian Journal of Animal Sciences* **85**: 316–19.

Martinez M L, Lee A J and Lm C Y. 1990. Multiplicative age-season adjustment factors by maximum likelihood, gross comparisons, and paired comparisons. *Journal of Dairy Science* **73**: 819–25.

Van Vleck L D and Henderson C R. 1961. Ratio factors for adjusting monthly test-day data for age and season of calving and ratio factors for extending part lactation records. *Journal of Dairy Science* **44**: 1093–1101.