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ABSTRACT

Projection factors based on production on the last day of sampling were developed for dairy goat milk and fat records. The 305-day lactation was divided into 13 stages varying from 10 to 40 days. The shortest stages were in early lactation. Sets of factors were developed for four ages at freshening, two seasons, two levels of herd production, and two breed groups. These classifications were necessary to avoid bias and improve accuracy. Cumulative yield factors also were developed with the same grouping of records. These factors are used when production for the last sample day is not available.

INTRODUCTION

The Dairy Herd Improvement program gradually has been adapted to improve service to goat herds. Dairy record processing centers (DRPC) have adapted their computing systems to process dairy goat records. Some aspects of the processing service rely on research results that are not available for goats. Partial records of cows routinely are extended to a 305-day equivalent to facilitate comparisons among records of different lengths. This has not been possible for dairy goat records. The purpose of this study was to develop factors appropriate for projecting dairy goat records to a 305-day standard. This standard may not be the most appropriate for goats because of large variation in length of production period. Many goats stop lactating before 305 days. The selection of a shorter standard period would reduce this variation; however, the 305-day standard is accepted by the American Dairy Goat Association.

Research by Steine (1) indicated that the best method of extending dairy goat records was to predict the remaining yield with a factor times the production on the last day of sampling and to add this prediction to the partial record instead of using a factor times the partial record to predict 305-day yield. Work on dairy cattle records (2) confirmed that reduction in error variance is possible with the last-sample day method. In order to apply this technique to goat records, allowance must be made for environmental factors specifically affecting the projection of goat records. Adapting the findings from dairy cattle, last-sample day factors were developed for dairy goat records.

MATERIALS AND METHODS

Milk and fat production on day of sampling were from dairy goat records processed at the Utah, New York, and Wisconsin DRPC. Records on 3707 lactations were available which met the following requirements: 1) 30 to 305 days in milk, 2) a normal termination, 3) a sample day within 55 days of parturition, 4) 8 to 104 mo of age at parturition, and 5) a 12-mo herd average record available on the herd. Alpines, La Manchas, Saanens, Toggenburgs, Nubians, and Crossbreds were represented.

The 305-day yields and partial yields through each sample day were computed from yields on sample day without adjustments to the first, second, and last-sample periods because factors appropriate for dairy goat records had not

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been derived. The ratio of average remaining yield to the average of production on the last-sample day times days remaining (305 minus days in milk) was computed for subclasses of age, season, stage of lactation, breed, trait, and herd production. The 305-day yield is predicted as $Y_{305} = Y_n + \text{Factor} \cdot LP \cdot (305\text{-}n)$, where Y_n is the cumulative yield to the *nth* day in milk with a yield of LP on that day. Changes in this ratio from group to group and the number of records available were considered in final definitions of groups. To provide factors to project records when production on the last-sample day is not available, cumulative yield factors also were developed with the same groupings as the last-sample factors. The average yield of the partial record is substituted for production on the last sample-day in this case. The 305-day yield is predicted with a factor for cumulative yield as:

$$\hat{Y}_{305} = Y_n + \text{Factor} \cdot (Yn/n) \cdot (305\text{-}n)$$

$$= [1 + \text{Factor} \cdot (305\text{-}n)/n] \cdot Y_n.$$

The last part of the expression illustrates how

TABLE 1. Last-sample day factors[a] for milk records of goat breeds other than Nubian.

Herd yield	Day at end of stage	8 to 19 mo[b]		20 to 31 mo[b]		32 to 55 mo[b]		56 mo[b]	
		Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]
< 726 kg	15	.95	.72	.80	.66	.76	.64	.59	.52
	25	.76	.65	.78	.62	.68	.62	.59	.52
	35	.72	.61	.71	.57	.68	.61	.58	.50
	55	.69	.55	.69	.57	.64	.60	.56	.50
	95	.66	.52	.64	.55	.63	.59	.55	.49
	135	.69	.56	.63	.55	.62	.61	.56	.50
	165	.72	.58	.64	.57	.63	.63	.58	.52
	195	.72	.59	.65	.61	.63	.67	.61	.54
	215	.74	.68	.65	.64	.66	.68	.63	.62
	235	.77	.76	.67	.67	.66	.71	.66	.62
	255	.81	.86	.69	.71	.67	.73	.69	.69
	275	.86	.82	.73	.74	.70	.76	.75	.74
	305	.94	.80	.82	.77	.79	.81	.75	.77
	Number[d]	35	79	99	91	104	75	60	42
≥ 726 kg	15	1.09	.85	.91	.74	.86	.70	.80	.68
	25	1.00	.84	.87	.73	.79	.69	.73	.65
	35	.97	.72	.79	.69	.75	.65	.71	.59
	55	.87	.69	.79	.65	.73	.63	.69	.58
	95	.83	.65	.73	.65	.71	.63	.69	.56
	135	.82	.68	.74	.68	.70	.66	.68	.60
	165	.81	.70	.75	.70	.73	.66	.71	.61
	195	.83	.72	.77	.71	.73	.69	.72	.64
	215	.84	.75	.76	.80	.74	.75	.73	.68
	235	.85	.76	.77	.84	.76	.76	.73	.73
	255	.88	.79	.79	.86	.77	.79	.73	.76
	275	.86	.84	.80	.89	.77	.81	.71	.88
	305	.82	.85	.81	.82	.79	.83	.71	.83
	Number[d]	344	305	536	236	618	294	394	179

[a]Estimated 305-day yields = part yield + Factor • (last-sample day yield) • (305 - length of part record).

[b]Age at kidding.

[c]Month of kidding.

[d]Number of sample day production records used for the 96 to 135-day stage.

the traditional factors for cumulative yield can be produced from these factors.

RESULTS AND DISCUSSION

Last-sample factors for milk yield are in Tables 1 and 2. The influence of age is shown by the gradual reduction in size of the factor with increasing age of doe. The 13 stages are of varying lengths to accommodate early rapid change and the middle period of little change. The factors decline rapidly until around 100 days in milk and then increase gradually. In groups in which the factors did not follow a smooth curve, the factors were smoothed. The decline in the factors early in lactation may reflect a gradual increase in daily yield which causes the average daily remaining yield to be a smaller fraction of the last-sample yield. The rise toward the end may be due to the shortening of the period between the last-sample day and the middle of the remaining period, the point when the average production for the rest of lactation would be expected. As this period becomes shorter, those yields become more similar. The difference between winter and spring kidding is most apparent early in lactation and declines as lactation progresses. Goats are

TABLE 2. Last-sample day factors[a] for Nubian milk records.

Herd yield	Day at end of stage	8 to 19 mo[b]		20 to 31 mo[b]		32 to 55 mo[b]		56 mo[b]	
		Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]
< 726 kg	15	.79	.53	.73	.69	.62	.55	.60	.61
	25	.76	.51	.67	.62	.59	.53	.56	.50
	35	.73	.48	.63	.53	.58	.54	.55	.48
	55	.71	.43	.57	.50	.58	.50	.52	.45
	95	.66	.42	.60	.51	.58	.53	.52	.44
	135	.69	.41	.63	.52	.60	.52	.50	.44
	165	.70	.43	.57	.55	.59	.64	.45	.44
	195	.70	.56	.59	.60	.60	.64	.40	.44
	215	.72	.57	.54	.65	.57	.67	.49	.50
	235	.74	.72	.65	.73	.56	.72	.52	.51
	255	.81	.72	.70	.82	.63	.73	.54	.55
	275	.78	.69	.82	.87	.61	.76	.58	.59
	305	.88	.69	.84	.87	.62	.72	.60	.65
	Number[d]	27	90	79	49	75	47	38	27
≥ 726 kg	15	.91	.84	.78	.73	.74	.68	.71	.48
	25	.88	.69	.78	.78	.72	.58	.71	.48
	35	.84	.66	.76	.74	.70	.56	.66	.48
	55	.79	.64	.72	.70	.64	.55	.63	.44
	95	.74	.59	.69	.63	.64	.51	.60	.44
	135	.73	.57	.69	.61	.64	.52	.61	.42
	165	.73	.61	.70	.63	.64	.52	.61	.42
	195	.73	.61	.76	.63	.64	.52	.62	.42
	215	.73	.61	.77	.63	.67	.52	.62	.50
	235	.76	.61	.78	.63	.68	.52	.62	.53
	255	.79	.68	.79	.66	.76	.53	.65	.63
	275	.76	.71	.83	.69	.72	.67	.79	.64
	305	.70	.80	.70	.71	.65	.72	.68	.64
	Number[d]	65	78	91	50	103	63	56	20

[a]Estimated 305-day yields = part yield + Factor • (last-sample day yield) • (305 - length of part record).

[b]Age at kidding.

[c]Month of kidding.

[d]Number of sample day production records used for the 96 to 135-day stage.

largely seasonal; few kid in summer or fall. The records from these off-season kiddings are highly variable, especially in total number of days in milk. Therefore, factors will be less accurate for these records.

Nubians are relatively lower than other breeds in milk production and higher in percentage of fat. These differences also were reflected in the factors so that a separate set in Table 2 was required for Nubians. The other breeds differed little. Herd production was used to improve the accuracy of the factors; 726 kg was selected to distinguish between commercial operations in which most goats would milk for 10 mo and lower producing units in which the anticipated production is correspondingly lower. A comparison of factors illustrates the sizable difference between these groups. Milk and fat require separate sets of factors because of the change in the percentage of fat in the milk over the course of lactation. Factors for fat yield are in Tables 3 and 4.

Factors for cumulative yield of milk (available from the authors) differ from the last-sample factors because they are based on the average production on all sample days rather than just the last-sample day. In the 1st mo, the sets of factors differed little because they both used the same information, but as the lactation progressed they became different. Last-sample factors first decrease, then increase, whereas the cumulative factors generally decrease.

The factors will enable goat dairymen to compare fairly records of goats at all stages of

TABLE 3. Last-sample day factors[a] for fat records of goat breeds other than Nubian.

Herd yield	Day at end of stage	8 to 19 mo[b]		20 to 31 mo[b]		32 to 55 mo[b]		56 mo[b]	
		Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]
< 726 kg	15	.71	.60	.63	.55	.57	.55	.45	.47
	25	.60	.64	.64	.56	.57	.56	.51	.54
	35	.60	.62	.60	.57	.54	.60	.54	.50
	55	.68	.58	.62	.58	.61	.60	.56	.50
	95	.68	.59	.64	.59	.63	.62	.57	.50
	135	.75	.60	.71	.62	.67	.63	.58	.54
	165	.77	.62	.74	.64	.72	.72	.65	.59
	195	.83	.63	.74	.67	.73	.72	.65	.61
	215	.86	.66	.75	.68	.73	.72	.71	.65
	235	.87	.76	.76	.73	.73	.79	.73	.67
	255	.88	.81	.78	.78	.73	.82	.75	.82
	275	.90	.82	.83	.75	.76	.77	.89	.82
	305	.93	.75	.82	.68	.79	.64	.70	.76
≥ 726 kg	15	.91	.82	.71	.67	.68	.66	.66	.64
	25	.90	.82	.71	.67	.68	.66	.65	.64
	35	.83	.73	.74	.67	.68	.65	.64	.60
	55	.83	.72	.74	.67	.68	.65	.64	.60
	95	.82	.71	.74	.69	.69	.66	.67	.60
	135	.84	.77	.76	.76	.72	.73	.68	.66
	165	.87	.77	.81	.77	.77	.73	.73	.67
	195	.89	.77	.83	.77	.79	.74	.75	.69
	215	.92	.77	.83	.83	.80	.76	.76	.70
	235	.92	.78	.84	.84	.81	.79	.77	.72
	255	.91	.79	.84	.86	.80	.82	.73	.77
	275	.87	.84	.83	.87	.80	.82	.72	.87
	305	.82	.84	.81	.81	.80	.82	.72	.82

[a]Estimated 305-day yields = part yield + Factor • (last-sample day yield) • (305 - length of part record).

[b]Age at kidding.

[c]Month of kidding.

TABLE 4. Last-sample day factors[a] for Nubian fat records.

Herd yield	Day at end of stage	8 to 19 mo[b]		20 to 31 mo[b]		32 to 55 mo[b]		56 mo[b]	
		Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]	Nov to Mar[c]	Apr to Oct[c]
< 726 kg	15	.67	.48	.65	.65	.59	.62	.47	.53
	25	.75	.48	.65	.62	.52	.62	.50	.50
	35	.76	.49	.65	.59	.56	.62	.51	.50
	55	.82	.49	.63	.60	.61	.59	.52	.47
	95	.83	.50	.63	.61	.63	.59	.54	.48
	135	.80	.51	.63	.63	.68	.60	.58	.48
	165	.76	.53	.62	.65	.68	.71	.58	.48
	195	.74	.57	.63	.66	.68	.71	.58	.48
	215	.72	.61	.66	.67	.62	.71	.58	.50
	235	.71	.65	.71	.73	.60	.71	.58	.50
	255	.81	.67	.76	.76	.60	.72	.58	.53
	275	.85	.68	.87	.88	.60	.72	.58	.57
	305	.86	.70	.86	.85	.62	.73	.58	.59
⩾ 726 kg	15	.85	.79	.75	.74	.67	.62	.65	.43
	25	.83	.77	.75	.74	.68	.60	.64	.45
	35	.82	.75	.74	.74	.69	.60	.63	.50
	55	.78	.73	.71	.74	.69	.60	.62	.50
	95	.77	.71	.74	.74	.69	.58	.62	.50
	135	.77	.69	.76	.74	.69	.58	.62	.49
	165	.79	.69	.81	.74	.70	.58	.63	.47
	195	.80	.69	.81	.74	.70	.54	.64	.43
	215	.80	.60	.81	.72	.70	.52	.64	.49
	235	.80	.60	.81	.68	.70	.50	.65	.52
	255	.80	.65	.81	.64	.70	.49	.66	.62
	275	.74	.69	.83	.65	.70	.66	.68	.65
	305	.70	.78	.68	.69	.70	.69	.70	.65

[a]Estimated 305-day yields = part yield + Factor • (last-sample day yield) • (305 - length of part record).

[b]Age at kidding.

[c]Month of kidding.

lactation. These extended records will enable more accurate culling and breeding decisions and are a first step towards genetic evaluations of goats. As additional goat records become available, these factors should be reevaluated because they are based on limited data. The large variation in the number of days in milk reduces the accuracy of the factors. As dairy goat operations become more commercial, more uniformity in the length of lactation would be expected; thus, more accurate factors should be possible. If yields improve, a goal that this work should facilitate, the 726 kg value which separates herds will become obsolete, and accuracy probably would be improved by raising this amount and computing new factors.

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