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# Age-Season Adjustment Factors Considering Herd Feeding Practices

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## ABSTRACT

The influence of percent of net energy in the herd's ration derived from concentrates on age-season effects was studied in New York Holstein Dairy Herd Improvement records. Ten feeding groups were defined by herd-feeding information. There was some increase in milk yield with an increasing proportion of concentrates in the ration. For six of these groups, the two highest, two middle, and two lowest in percent net energy from concentrates, age-season effects were calculated. The trends in age effects and seasonal effects were similar for all groups with the groups having a higher fraction of net energy from concentrates showing relatively higher mature milk yield. The multiplicative age-season factors calculated from the age-season solutions were similar for all groups, indicating that the proportion of concentrates over the current range does not have an important influence on age-season factors.

## INTRODUCTION

Accurate age-season adjustments are necessary to compare records from cows at different ages, freshening at different times. The adjustments also allow for the use of records of cows of various ages and seasons of freshening in evaluating bulls. If concentrate feeding were to change because of increased use for human consumption or other reasons, feeding a larger proportion of roughages in the ration might change the pattern of age-season effects resulting in a need for different age-season factors. The purpose of this study was to investigate on a herd basis whether age-season effects are different for cows fed a low proportion of concentrates as compared to those fed rations with a high proportion of concentrates.

## MATERIALS AND METHODS

New York Holstein lactation records from herds in the Dairy Herd Improvement Program were divided into 10 groups based on percent net energy from concentrates as defined in Table 1. Age-season factors were calculated for six of these groups representing low, medium, and high proportions of concentrates in the ration. The 12-mo rolling herd average for percent net energy from concentrates beginning 2 mo prior to freshening was used to classify the production records for all cows in the herd at that time. This system permitted a herd to change classification with time.

Following the procedure of Miller (1), age-season factors were calculated for each feeding group by the model:

$$y_{ijkl} = HY_i + C_j + AS_k + A_l + e_{ijkl}$$

where  $y_{ijkl}$  is the actual 305-day milk record of the  $j$ th cow freshening in the  $i$ th herd-year at age  $l$  in the  $k$ th age-month of freshening group;  $HY_i$  is the effect of the  $i$ th herd-year;  $C_j$  is the random effect of the  $j$ th cow;  $AS_k$  is the effect of the  $k$ th age-month of freshening group;  $A_l$  is

TABLE 1. Description of feeding groups and numbers of records in each group.

Feeding group		% NE from concentrates	Numbers of records
Low	1	≤34	111,116
	2	35–37	123,352
	3	38–40 <sup>a</sup>	
	4	41–42 <sup>a</sup>	
Medium	5	43–44	160,246
	6	45–46	151,608
	7	47–48 <sup>a</sup>	
	8	49–50 <sup>a</sup>	
High	9	51–55	157,465
	10	≥56	144,518

<sup>a</sup>Age-season factors were not calculated for these groups.

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the effect of the  $l$ th age; and  $e_{ijkl}$  is a random error. Cow and error effects were independently distributed with zero means and  $\sigma_e^2 = .8 \sigma_c^2$  (a repeatability of .444). Cows were assumed to have records only in one herd. There were 72 AS effects and 23 A effects which are defined in Table 2.

The six age groups used in forming age-season groups were subdivided to form 23 age groups to allow more precise estimation of age effects. The procedure consisted of the following steps:

1. Select actual milk production records with the following properties:
  - A. Holstein from New York
  - B. Age at freshening between 18 and 200 mo
  - C. Herd feeding information available
  - D. In milk longer than 60 days
  - E. Freshened during period June 1966 to August 1975
  - F. Lactation ended normally
2. Build the AS and A equations as well as the HY equations for that herd while absorbing the cow equation into the AS, A, and HY equations for each cow. At the end of a herd, absorb the herd-year equations into the AS and A equations.
3. Solve the sets of equations after imposing constraints setting the 18 to 28 mo of age—January month of freshening group and one age subdivision in each of the large age groups to zero.
4. Convert the solutions to estimated production as follows: add the mean production of January freshening, 18- to 28-mo-old cows to all the AS solutions; adjust these values by the A solution; and interpolate within age groups to obtain values for each month of age and month of freshening.
5. Calculate the age-season factors by dividing the estimated production of cows 78 mo old freshening in September by the

TABLE 2. Groupings used to define age at freshening and age-season of freshening effects.

Age-season effects		Age effects	
Months of age	Subscripts for AS effects (12 months of freshening)	Months of age	Subscripts for A effects
18–28	1 <sup>a</sup> –12	18–21	1
		22	2
		23	3
		24	4 <sup>a</sup>
		25–26	5
29–34	13–24	27–28	6
		29–30	7 <sup>a</sup>
		31–32	8
		33–34	9
		35–37	10 <sup>a</sup>
35–37	25–36	38–42	11 <sup>a</sup>
38–42	37–48	43–49	12 <sup>a</sup>
43–62	49–60	50–62	13
63–200	61–72	63–70	14 <sup>a</sup>
		71–75	15
		76–80	16
		81–83	17
		84–86	18
		87–90	19
		91–96	20
		97–120	21
		121–144	22
		145–200	23

<sup>a</sup>These effects were set to zero in order to obtain solutions. One A effect is set to zero within each age group of the AS effects.

TABLE 3. Average milk yield (kg) for January freshening Holstein cows.

Feeding group		Age at freshening			
		18-28 months		63-200 months	
		Milk yield	Number of records	Milk yield	Number of records
Low	1	4686	1406	5886	3092
	2	4986	1638	6244	3295
Medium	5	5278	2346	6693	4077
	6	5348	2370	6719	4106
High	9	5540	2424	7018	4337
	10	5527	2175	6833	4084

estimated production for the appropriate month of age, month of freshening group.

### RESULTS AND DISCUSSION

Proportion of concentrates in the ration and

production were related as in Table 3 with a difference of about 1000 kg between the low and high groups. The mean for cows 18 to 28 mo of age freshening in January is added later to the solutions in Table 4 producing lactation yield values for each age group.

TABLE 4. Solutions<sup>a</sup> (kg) for age effects of September freshening Holstein cows for herds feeding different proportions of concentrates.

Month of age at end of interval	Herd feeding group					
	Low		Medium		High	
	1	2	5	6	9	10
18-21	-286	-169	-363	-368	-392	-327
22	-211	-175	-320	-236	-348	-333
23	-194	-103	-212	-131	-113	-220
24	-1	-30	-56	-9	-87	-106
26	28	58	31	86	34	-20
28	123	147	142	193	165	113
30	167	279	256	297	301	171
32	251	387	355	380	417	273
34	370	474	445	516	494	365
37	450	514	633	627	654	537
42	619	745	808	833	815	694
49	864	1027	1094	1159	1157	987
62	1171	1325	1406	1475	1469	1288
70	1314	1438	1546	1601	1622	1484
75	1303	1470	1583	1643	1644	1515
80	1394	1521	1627	1675	1705	1556
83	1389	1553	1665	1694	1723	1549
86	1337	1522	1651	1688	1715	1562
90	1375	1508	1624	1694	1705	1553
96	1366	1520	1635	1684	1673	1569
120	1312	1465	1537	1599	1609	1456
144	1134	1276	1363	1400	1444	1282
200	827	1000	1127	989	1020	984

<sup>a</sup>The solutions are deviations from the January freshening 24 months of age group.

In Table 4, there is evidence of a greater increase in production with age in the high feeding group over the low group. Peak yield occurred around the 81- to 83-mo age group for all feeding groups. Yield rose steadily with age to about 4 yr then less rapidly to maturity for cows in all feeding groups. Feeding groups seem to differ only in production and not in rate of maturity or age at peak production.

Examples of effects of month of freshening are in Table 5. There was considerable variation in lactation yield due to month of freshening. April through August freshening cows were the lowest producers with October and November the highest months for all groups. Effect of month of freshening for all by feeding groups was similar.

Estimating 72 age-season effects permits a different effect of month of freshening for the six age groups. In Fig. 1, month effects are similar for all age groups although the absolute differences are magnified at higher production. Preliminary work with records from cows in New England indicated that their effects of age-season followed the same trends in the New York data.

A sample of the age-season factors by feeding group is listed in Table 6. The factors are nearly the same for all feeding groups showing little effect of the classification by feeding group. The higher production in the feeding groups with higher fraction of net energy from concentrates did not produce

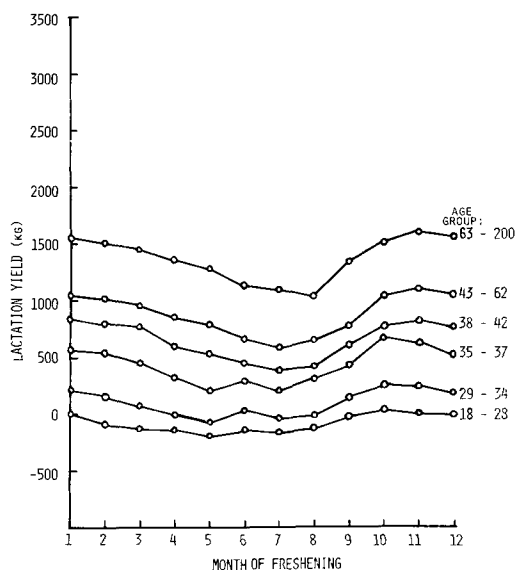


FIG. 1. Effect of age of freshening on monthly variation for cows in herds feeding a low proportion of concentrates (Group 1).

different factors. The factors are a ratio of mature yield to yield at a specific age. Since the feeding groups with a higher mature yield also had higher yields at the other ages, it was possible for the factors to be almost the same across feeding groups with increasing production.

TABLE 5. Solutions (kg) for month of freshening for cows 24 mo of age at freshening for herds feeding different proportions of concentrates.

Month of freshening	Herd feeding group					
	Low		Medium		High	
	1	2	5	6	9	10
January	0	0	0	0	0	0
February	-89	-35	-62	-24	-56	-45
March	-156	-86	-98	-16	-73	-49
April	-167	-175	-214	-136	-113	-89
May	-209	-235	-201	-146	-153	-200
June	-163	-272	-222	-128	-166	-183
July	-193	-160	-233	-196	-206	-287
August	-158	-98	-117	-137	-140	-192
September	-1	-30	-56	-9	-87	-106
October	50	51	26	97	34	34
November	33	39	54	89	88	34
December	25	21	30	78	27	-4

TABLE 6. Comparison of age-season factors estimated from records in herds feeding different proportions of concentrates for September freshening Holstein cows.

Age at freshening (months)	Herd feeding group					
	Low		Medium		High	
	1	2	5	6	9	10
24	1.298	1.333	1.323	1.316	1.329	1.307
28	1.261	1.259	1.267	1.261	1.262	1.252
32	1.224	1.206	1.221	1.219	1.212	1.216
36	1.185	1.171	1.169	1.176	1.169	1.169
40	1.145	1.134	1.133	1.134	1.138	1.137
44	1.113	1.100	1.101	1.099	1.102	1.105
48	1.085	1.073	1.074	1.070	1.073	1.073
52	1.060	1.051	1.053	1.048	1.052	1.057
56	1.038	1.031	1.033	1.029	1.033	1.038
60	1.028	1.024	1.024	1.022	1.024	1.027
72	1.018	1.010	1.008	1.006	1.009	1.007
84	1.011	.999	.996	.998	.998	.999

### CONCLUSIONS

Lactation milk production is influenced by age and month of freshening of the cow. The proportion of the ration from concentrates over the range of herds did not identify groups of records which require different age-season adjustments. There was a nearly linear increase in yield with age at early ages for all groups with a leveling off as maturity approached. Peak production occurred at about the

same age for all groups.

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