RESULTS AND DISCUSSION

4 . RESULTS AND DISCUSSION

4 .1 Non–Genetic Aspects

4 .1:1 Age at First calving

4.1.1.1 Mean and variation

Actual mean , standard deviation and coefficient of variability for age at first calving of Holstein Friesian cattle used in the present study are presented in table 7 . That mean being 23.7 ± 1.7 months reveal that Holstein Friesian cows of the study gave birth for their first calves at an earlier age than reported on the same breed in the literature cited from the previous Egyptian research of 24.3 months (Table.1) . This mean is also lower than those obtained for Holstein Friesian cattle raised in countries other than Egypt (mostly Non-European) except those reported by **Kulak *et al* (1997a&b)** on Holstein cattle raised in Canada (Table 1) . At the same time age at first calving in this work (23.7 months) is lower than those reported in the available literature on Friesian cattle raised either in Egypt or in countries other than Egypt (Table 1) .

The relatively earlier age at first calving than most of those reported in the Egyptian cited literature would refer to the better control , management , feeding system and care prevailed in the herd under study .

The coefficient of variation obtained as shown in table 7 (6.8 % ed from 8.8 to 12.0% in Holstein cattle and from 9.1 to 10.9% in Friesian ca) for age at first calving is lower than those available in the literature cited which rang ttle (Tables 1&7) .

Table 7 . Actual mean, standard deviation and coefficient of variation for age at first calving in Holstein Friesian cattle .

Item	Estimate
Actual mean (month)	23.7
Standrad deviation	1.6
Cofficient of variation (CV%)	6.3
Number of cows	1029.0

CV% was calculated as the percentage of square root of the error mean square of the trait divided by its actual mean.

4.1.1.2 Year-of-birth effect

Least squares analysis of variance presented in table 8 show that year of birth did not exert any significant effect on age at first calving . This fairly agrees with results of **Galal *et al* (1981)** who found that year of birth was not able to affect age at first calving significantly and disagrees with most of the cited literature (**Basu *et al* , 1979 ; Mohamed , 1979 ; Abdel-Glil , 1985 ; Morsy *et al* , 1986 ; Silva *et al* , 1986 ; Arafa , 1987 ; El-Sedafy , 1989 ; Khattab and Sultan , 1990a&b ; Afifi *et al* , 1992 ; Neiva , 1992 ; El-Khashab , 1993 ; Mokhar *et al* , 1993 ; El-Sheikh , 1995)** . The non-significant year-of-birth effect reached in this study might be due to the very limited years of birth for cows of the study (two years only) . Year effect on age at first calving is deemed to be due to year changes in management , feeding system , care for the heifers , stockman`s skill ; disease attack and climatic conditions . Rate of growth and size of the heifer could be added in this respect . **Sultan and Khattab (1989)**

Table 8 . F- ratios of the least squares analysis of variance for age at first calving in Holstein Friesian cattle.

Source of variance	Degrees of freedom	F-ratio
Sire	138	1.76***
Year of birth(Y)	1	0.07ns
Season of birth(S)	3	11.32***
YxS	3	17.42***
Remainder	883	
Remainder mean squares		2.26

ns = non significant, *** = 0.001

attributed year differences in age at first calving to nutritional and managerial conditions prevailing during different years .

4.1.1.3 Season-of-birth effect

Results in table 8 reveal that season of birth contributed significanly ($p < 0.001$) to the variance in age at first calving . This agrees with results of **Aboustate (1975) , Arafa (1987) , El-Sedafy (1989) , Khattab and Sultan (1990b) , Afifi *et al* (1992) and El-Khashab (1993) .** They observed that age at first calving in either the imported or locally born Friesian and Holstein heifers was significantly ($p < 0.05$ or $p < 0.01$) influenced by season of birth . On the other hand , **Abdel-Glil (1985) , Koul et al (1985) and Mohamed (1987)** proved that the effect of season of birth was not significant on age at first calving .

Data in table 9 gave evidence that summer-born heifers was the earliest in their age at first calving when compared to those born during other seasons of the year . Different patterns for the effect of season of the year on age at first calving of dairy cattle raised in Egypt were detected by different investigators , but most of the literature cited indicated that autumn- and winter-born cows gave their first calves earlier than those born in other seasons of the year **(Abdel-Glil , 1985 ; Mohamed , 1987 ; El-Sedafy , 1989 ; El-Khashab , 1993) .**

Difference in the trend of the effect of season of birth of cows on age at first calving might be due to differences in the genetic make-up , number of the heifers used , management , feeds , feeding system and components of the statistical model used in the analysis .

Table 9 . Least squares means ± SE of factors affecting age at first calving in Holstein Friesian cattle .

Independent Variables	N	Mean ± SE (months)
Year of birth		
1981	372	23.90± 0.13
1983	657	23.87± 0.16
Season of birth		
Winter	170	24.31± 0.16
Spring	317	23.97± 0.12
Summer	257	23.37± 0.13
Autumn	285	23.89± 0.15

4.1.1.4 Year of birth x season of birth interaction effect

The interaction effect between year of birth and season of birth effect was significant ($p< 0.001$) as shown in table 8 . F-ratios in the same table indicate that year of birth x season of birth interaction was the most important non-genetic factor included in the analysis in influencing age at first calving in the herd of the study .

4.1.2 Longevity traits

Longevity traits in this work involved age at last calving , length of productive life , length of herd life and number of lactations completed .

4.1.2.1 Means and variations

Actual means , standard deviations and coefficients of variability for different longevity traits of the study are given in table 10 .

Table 10 Actual means, standard deviations (SD) and coefficients of variation for longevity traits in Holstein Friesian cattle .

Trait	N	Mean	SD	CV%
Age at last calving(month)	1029	91.2	22.62	24.22
Length of Productive life				
in month	1029	80.7	24.01	28.88
in days	1029	2420.9	720.36	28.88
Length of herd life				
in month	1029	104.4	23.90	22.32
in days	1029	3132.2	716.98	22.32
Number lactations completed	1029	5.5	1.41	24.96

CV% of a given trait was calculated as the percentage of square root of the error mean square of the trait divided by its actual mean .

The mean obtained for age at last calving (91.2 months) in Holstein Friesian cattle (Tabie 10) is higher than 58.8 months reached by **White and Nichols (1965)** for cows of the same breed but lower than

93.3 months estimated by **Mokhtar** ***et al*** **(1985)**. Means of length of productive life and length of herd life (80.7 and 104.4 months , respectively) are higher than the corresponding means reported in the available literature in either Holstein Friesian or Friesian cattle (Table 2). The mean of number of lactations completed was estimated as 5.5 lactations (Table 10). This mean is higher than most means found in the available literature on Holstein Friesian cattle which ranged from 2.9 to 5.6 lactations and all those of Friesian cattle which ranged from 2.7 to 5.3 lactations (Table 2) . All these results reveal that cows of the present work remained longer in the herd than those of the different cited research . cofficients of variation (V%) for longevity traits ranged form 22.32 to 28.88 % (Table 10) . These percentages reveal that variation percent for age at last calving (24.22 %) was higher than that of herd life(22.32%) and lower than those of length of productive life(28.88 %)and number of lactation completed (24.96 %)

Variation percent in length of productive life obtained herein (24.22 %) is lower than its correspondings calculated for Holstein Friesian and Friesian cattle by **Hargrove** ***et al*** **(1969) ; Hoque and Hodges (1980) , Sultan and Khattab (1989) and Khattab** ***et al*** **(1994)** which ranged from 26.4 to 77.5 % . Variation percent for herd life (22.32 %) is higher than 19.1 % estimated by **Sultan and Khattab (1989)** for Friesian cattle . Precent of variation in number of lactations completed (24.96 %) is considerably lower than its correspondings reported in the cited literature which ranged from 47.1 to 66.7 % (Table2) for Holstein Friesian cattle and from 43.5 to 46.1 %for Friesians.High or moderate percent of variability in a given trait permits the possibility for its improvement through phenotypic selection .

4.1.2.2 Year-of-birth effect .

Results in table 11 indicate that longevity traits of the study varied with year of birth significantly ($p < 0.01$ or $p < 0.001$) . F-ratios for the effect of year of on these traits when compared with those of the other factors included in the model of the analysis proved that it had a considerable contribution to the variance of these traits , the differences were in favour of 1983 year (Table 12) . These results are in fair agreement with those of **Sultan and Khattab (1989)** who found that year of birth in Friesian cows showed a significant ($p < 0.01$) effect on length of productive life , length of herd life and number of lactations completed .

4.1.2.3. Season-of-birth effect

Season of birth of the cow did not show any significant effect on all longevity traits of the study (Table11), but there is a consistent trend indicating that differeneces among seasons of birth in these traits were in favour of summer-born cows which recorded the latest age at last calving , the longest productive life and herd life and the greater number of lactations completed (Table 12) . **Ponce and Gomez (1988)** reported that length of herd life and number of calvings (as longevity traits) given by the Holstein Friesian cow during its productive life were not significantly influenced by season of birth .Also , it was indicated by **Sultan and Khattab(1989)** that

Table 11 F- ratios of the least- squares analyses of variance for longevity traits in Holstein Friesian cattle.

Source of variance	df	Age at last calving	Length of productive life (in months)	Length of productive life (in days)	Length Herd life (in months)	Length Herd life (in days)	Number lactations Completed
Sire	138	1.39**	1.39**	1.39**	1.39**	1.39**	1.35**
Year of birth	i	16.00***	18.82***	18.82***	18.82***	18.82***	9.68**
Season of birth	3	0.84 ns	0.70ns	0.70ns	0.70ns	0.70ns	1.63ns
Year xSeason	3	5.89***	5.62***	5.62***	5.62***	5.62***	5.72***
Regression on age at first calving							
Linear	1	1.20ns	7.31**	7.31**	0.94ns	0.94ns	12.31***
Quadratic	1	0.00ns	0.00ns	0.00ns	0.00ns	0.00ns	0.001ns
Regression on first lactation 305-day milk yield							
Linear	1	19.49***	21.02***	21.02***	21.02***	21.02***	16.73***
Quadratic	1	6.85**	8.18**	8.18**	8.18**	8.18**	5.59*
Remainder df	879						
Remainder mean squares		487.72	543.07	488761.32	543.07	488761.32	1.89

ns = non-significant, * = p < 0.05 , ** = p < 0.01 , *** = p< 0.001.

Table 12 Least squares means ± SE of fixed factors affecting longevitiy traits in Holstein Friesian cattle.

Independent variables	N	Age at last calving	Productive life		Herd life		Number of lactation completed
			(in months)	(in days)	(in month)	(in days)	
Year of birth							
1981	372	86.12±2.08	74.95±2.19	2248.6± 65.9	98.6±2.2	2960.0± 65.9	5.24±0.13
1983	657	95.28±1.70	85.44±1.81	2563.2± 54.4	109.2±1.8	3274.6± 54.4	5.68±0.10
Season of birth							
Winter	170	89.79±2.40	79.46±2.49	2383.9± 74.8	103.2±2.5	3095.3± 74.8	5.36±0.10
Spring	317	89.79±1.80	80.15±1.93	2404.3± 58.1	103.8±1.9	3115.7± 58.1	5.54±0.14
Summer	257	92.88±1.98	82.33±2.09	2469.8± 62.8	106.0±2.1	3181.2± 62.8	5.63±0.12
Autumn	285	89.20±2.43	78.85±2.56	2365.6± 76.9	102.6±2.6	3077.0± 76.9	5.33±0.15
Year of birth x season of birth							
Winter-1981	47	91.47±3.60	80.54±3.84	2416.3±115.4	104.2±3.8	3127.6±115.4	5.49±0.23
Spring-1981	190	87.12±2.20	75.97±2.30	2279.0± 69.8	99.7±2.3	2990.5± 69.8	5.40±0.14
Summer-1981	95	85.29±2.87	74.01±3.03	2220.2± 90.9	97.7±3.0	2931.5± 90.9	5.25±0.18
Autumn-1981	40	80.59±4.08	69.30±4.30	2079.0±129.2	93.0±4.3	2790.3±129.2	4.82±0.25
Winter-1983	123	88.11±2.65	78.39±2.80	2351.6± 84.0	102.1±2.8	3063.0± 84.0	5.22±0.16
Spring-1983	127	94.66±2.67	84.32±2.82	2529.6± 84.6	108.0±2.8	3240.9± 84.6	5.67±0.16
Summer-1983	162	100.47±2.40	90.65±2.53	2719.4± 76.1	114.4±2.5	3430.8± 76.1	6.01±0.15
Autumn-1983	245	97.89±2.10	88.41±2.22	2652.3± 66.6	112.1±2.2	3363.7± 66.6	5.84±0.13

month of birth of the Friesian cow was not able to influence length of herd life , length of productive life and number of lactations completed during its life . In this respect , **Sharaby *et al* (1983)** indicated that season of birth of the Holstein Friesian cow showed a large amount of variability in length of productive and herd life . In consistent with the present results , they also observed that winter-born cows scored shorter herd life than summer-born ones . The effect of season of birth in this concern is thought to be due to changes in the availablility of green fodder ,its nutritive value and / or weather conditions specially ambient tempratures associated with season of the year .

4.1.2.4. Year of birth x season of birth interaction effect

The effect of the interaction between year of birth and season of birth was significant ($p < 0.001$) on all longevity traits of the study (Table 11) . The significant effect would indicate that the effect of season of birth on the traits under consideration differed from one year to another and this is clear when checking the least squares means presented in table 12 .

4.1.2.5 Age at first calving effect

Results in table 11 show that the effect of age at first calving was significant ($p < 0.01$ or $p < 0.001$)only for length of productive life and number of lactations completed . while non-significant on age at last calving and length of herd life . In this concern age at first calving was proved to have significant ($p < 0.01$) influence on length of herd life (**Ashmawy , 1985a)** ; on longevity (**Prasad and Manglik , 1987 ; Roy and Tripathi , 1990**) ; on length of productive life , length of herd life and number of lactations completed (**Sultan and Khattab , 1989**) .

Partial linear regression coefficients of all longevity traits of the study (age at last calving , length of productive life , length of herd life and number of lactations completed) on age at first calving were all negative but significant ($p < 0.01$ or $p < 0.001$) only on length of productive life and number of lactations completed . The quadratic regression coefficients of all longevity traits were very small , positive and non-significant . These results reveal that there existed a negative dependent relationship between age at first calving and each of length of productive life and number of lactations completed . These findings would indicate that as age at first calving becomes early , length of productive life and number of lactations completed are increased . This agree with results of **Asker** ***et al*** **(1954) and Ashmawy (1985a**) on number of lactations given by the cow during its productive life , with those of **Hargrove et al (1969) and Hoque and Hodges (1980)** on number of lactations initiated or given and length of productive life and those of **Gill and Allaire (1976)** on length of productive life . Similarly , **Sultan and Khattab (1989)** detected the presence of significant negative dependent relationship between age at first calving and each of length of productive life , length of herd life and number of lactations completed before disposal . All these results and those of the present study would lead to state that age at first calving is negatively associated with longevity traits , At the same time , such results confirm those of **Asker et al (1954)** who stated that in order to increase longevity of the dairy cow we should try to decrease age at first calving . Also , results of the present study and the other cited work indicate , in general , that selection for early age at first calving would increase number of lactations completed and prolong length of other longevity traits .

4.1.2.6 First lactation milk yield effect

First lactation 305-day milk yield was found to have significant ($p < 0.01$or $p < 0.001$) effect on age at last calving , length of productive life , length of herd life and number of lactations completed during the cow's productive life (Table 11) . These results are in consistent with those reported on length of herd life (**White and Nichols , 1965)** , length of productive life and number of lactations completed **(Hoque and Hodges , 1980)** , on number of lactation completed **(Ashmawy , 1985a)** and on length of productive life and number of lactions completed **(Sultan and Khattab,1989) .**

Results in table 13 show that estimates of linear regression coefficients of all longevity traits of the study on first lactation milk yield were positive while the quaratic ones were negative , both linear and quadratic regressions were significant ($p < 0.05$, $p < 0.01$ or $p < 0.001$) . These results indicate that there was a curvlinear relationship between first lactation milk yield and longevity traits which reveal that as first lactation milk yield increased longevity traits increased till reaching a certain level thenafter declined . In this respect , **White and Nichols (1965)** found a small but real positive correlation between first lactation milk yield and length of herd life. **Hargrove *et al* (1969)** showed that the correlation coefficient between first lactation milk yield and length of productive life was positive and a little bit high (0.43) . The genetic relationships between first lactation milk yield and longevity traits were proved to be possitive in the cited research (e . g. **Everett *et al* , 1976 ; Leroy , 1988 ; Sultan and Khattab , 1989) . Burnside *et al* (1984) , Mokhtar *et al* (1985) and Sultan and Khattab (1989)** reported that length of herd life appeared to have close positive relationship with high level of first lactation milk production (yield) .

Table 13 Least squares estimates of regression coefficients for longevity traits on age at first calving and first 305- day milk yield in Holstein Friesian cattle.

Longevity traits	Regression on age at first calving	Regression on first 305-day milk yield
Age at last calving		
Linear	-0.5987± 0.55 ns	0.0061±0.001 ***
Quadratic	$31x10^{-4}$± 0.17 ns	$-2x10^{-6}$±0.00 **
Length of productive life in months		
Linear	-1.5597± 0.57 **	0.0067±0.001 ***
Quadratic	$35x10^{-4}$± 0.18 ns	$-2x10^{-6}$±0.00 **
Length of productive life in days		
Linear	-46.7906±17.30 **	0.2012±0.04 ***
Quadratic	0.1059± 5.31 ns	$-7x10^{-5}$±0.00 **
Length of herd life in months		
Linear	-0.5597± 0.58 ns	$67x10^{-4}$±0.001 ***
Quadratic	$35x10^{-4}$± 0.18 ns	$-2x10^{-6}$±0.00 **
Length of herd life in days		
Linear	-16.7906±17.30 ns	0.2012±0.04 ***
Quadratic	0.1059± 5.30 ns	$-7x10^{-5}$ ±5.3 **
Number of lactations completed		
Linear	-0.1193± 0.03 ***	$4x10^{-4}$±0.00 ***
Quadraitic	$3x10^{-4}$± 0.01 ns	$-1x10^{-7}$±0.00 *

*= $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$, ns = non significant .

Parker et al ***(1960)*** suggested that high producer cows in their first lactation have a tendency to remain in the herd longer , i . e . to have longer herd life than low producer ones . Also , **Van Vleck (1964) , White and Nichols (1965) , Miller *et al* (1967) , Hoque and Hodges (1980) , De Lorenzo and Everett (1982) , Ashmawy (1985b) and Sultan and Khattab (1989)** observed that high milk producing cows in their first lactation remained in the herd longer than low producer ones ; i.e.had longer herd life ,productive life and /or number of lactations completed .

Van Vleck (1964) White and Nichols (1965) and Burnside ***et al*** **(1984)** concluded that high milk producing cows in their first lactation completed more subsequent lactations . Also , Sultan and Khattab (1989) found that the linear regression coefficient of number of lactations completed on first lactation milk yield was positive and significant ($p < 0.01$) .

Coupling the results on the effects of age at first calving and first lactation milk yield on longevity traits obtained in this work would lead to state that in order to increase longevity in dairy cattle , it is advisable to select for early first calving and high level of first lactation milk yield .

4.1.3 Lifetime Milk production Traits

Lifetime Milk production traits of the study comprised lifetime 305-day milk yield , lifetime total milk yield , lifetime days in milk , milk yield per day of lifetime days in milk , milk yield per day of productive life and milk yield per day of herd life .

4.1.3.1 Means and variation

Actual means , standard deviations and coefficients of variability are presented in table 14 . Means of lifetime 305-day milk yield (LIF305M) , lifetime total milk yield (LIFTM) and lifetime days in milk (LIFDM) , i.e. of the major lifetime milk production traits differed according to the data used (milk production data corrected by additive correction factors or milk production data corrected by multiplicative correction factors) . The highest means were recorded for LIF305M when using milk production data corrected by the multiplicative correction factors , for LIFTM when using milk production uncerrected data and for LIFDM when using the milk production data corrected by the multiplicative correction factors (Table 14) . Also , the lowest means were calculated for LIF305M and LIFTM when using milk production data corrected by using additive correction factors . These observations indicate that means of the three major lifetime milk production traits differed in their ranking according to type of data used .

Means of milk yield per day of lifetime days in milk (MYDLP) ,

Table 14 Actual means, standard deviations (SD), and coefficients of variation (CV%) for lifetime milk production traits using uncorrected and corrected data.

Trait	N	Using uncorrected data			Using data corrected by additive correction factors			Using data corrected by multiplicative correction factors obtained through polynomial regression		
		Mean	SD	CV%	Mean	SD	CV%	Mean	SD	CV%
Lifetime 305- day milk yield (kg).	1029	29025	10252	32.77	29504	9977	10.13	24498	7414	27.57
Lifetime total milk yield (kg).	1029	35741	13792	36.33	34803	12039	32.85	33720	11066	30.46
Lifetime days in milk(days)	1029	2169	841	38.06	2082	759	35.80	2480	903	35.74
Milk yield per day of lifetime days in milk (kg)	1029	17	3	18.09	17	3	17.72	16	3	17.29
Milk yield per day of productive life(kg).	1029	14	2	13.27	14	2	13.48	14	2	13.19
Milk yield per day of herd life(kg).	1029	11	2	18.04	11	2	15.79	10	2	13.99

CV% of a given trait was calculated as the percentage of square root of the error mean square of the trait divided by its actual mean .

milk yield per day of productive life (MYDPL) and milk yield per day of herd life(MYDHL) when using uncorrected lactation milk production data were similar to their corresponding means when using milk production data corrected by the additive correction factors . These means were a little bit fewer when using the data the multiplicative correction factors than when using the other two types of data .

Coefficients of variation in the major lifetimemilk production traits ranged from 32.77 to 38.06 % when using the milk production uncorrected data from , 10.13 to 35.80 % when using milk production data corrected by the additive correction factors and from 27.57 to 35.74 % when using milk production data corrected by the multiplicative correction factors .

These coefficients , in general , make the improvement of the major lifetime milk production traits through the phenotypic selection possible . Coefficients of variation in MYDLP , MYDPL and MYDHL ranged from 13.19 to 18.09 % .

Actual means of lifetime milk production traits (lifetime 305-day milk yield , lifetime total milk yield , lifetime days in milk and milk yield per day of productive life) are higher than their correspondings reported in the literature on Holstein Friesian cattle **(Hargrove *et al* ; 1969 , Hoque and Hodges , 1980) .**

Coefficients of variation in minor lifetime milk production traits (milk yield per day of lifetime days in milk , milk per day of productive life and milk yield per day of herd life) are generally lower than those of the three major lifetime milk production traits (lifetime 305-day milk yield , lifetime total milk yield and lifetime days in milk). This trend is expected since the coefficints of variation of the minor lifetime milk production traits are obtained by using values resulting from dividing lifetime total milk yield by lifetime days in milk , length of productive life or length of herd life . **Hargrove *et al* (1969) Hoque and Hodges (1980) , Sultan and Khattab (1989) and Khattab *et al* (1994)** with either Holstein Friesian or Friesian cattle reported lower means of LIF305M , LIFTM , MYDPL and LITDM but higher percentages of variation than those of the present study (Table 3 & 14) .

4.1.3.2 Year-of-birth effect

Year of birth was observed to have significant ($p < 0.05$, $p < 0.01$ or $p < 0.01$) effect on three of six of lifetime milk production traits when using the milk production uncerrected data , on most of these traits when using milk production data corrected by the additive correction factors and on all traits when using milk production data corrected by multiplicative correction factors (Table 15) . F-values presented in table 15 would indicate that the effect year of birth of the cow was more important than that of either season of birth or year of birth x season of birth interaction on milk production traits when analyzing the corrected data . In this respect , year of birth of the cow was proved to have significant ($p < 0.01$) effect on lifetime 305-day milk yield , lifetime total milk yield and / or milk yield per day of productive life(**Sharaby et al ,1983 ; Ponce and Gomez , 1988 ;**

Table 15 F-ratios of least squares analysis of variance of factors affecting lifetime milk production traits in Holstein Friesian cattle.

Source of varince	Df	Uncorrected data	Data corrected using ACFs[+]	Data corrected using MCFs[++]
i Lifetime 305-day milk yield				
Sire	138	1.24 ns	1.28 *	1.35 **
Year of birth(Y)	1	0.11 ns	19.48 ***	27.29 ***
Season of birth(S)	3	1.97 ns	0.85 ns	0.41 ns
Y x S interaction	3	6.75***	7.12 ***	7.77 ***
Regression on age at first calving				
Linear	1	5.59 *	5.37 *	26.29 ***
Quadratic	1	0.14 ns	0.07 ns	0.15 ns
Regression on first lactation 305- day milk yield				
Linear	1	69.70***	67.73 ***	108.35 ***
Quadratic	1	9.50**	10.46 **	13.23 ***
Remainder df	879			
Remainder mean squares		90451356.84	89394003.65	45618168.15
ii Lifetime total milk yield				
Sire	138	1.30*	1.29 *	1.38 **
Year of birth(Y)	1	0.80 ns	18.99 ***	27.88 ***
Season of birth(S)	3	1.38 ns	0.84 ns	0.60 ns
Y x S interaction	3	5.80 ***	6.77 ***	6.88 ***
Regression on age at first calving				
Linear	1	2.56 ns	4.91 *	14.75 ***
Quadratic	1	0.10 ns	0.04 ns	0.03 ns
Regression on first lactation 305- day milk yield				
Linear	1	71.19 ***	66.03 ***	94.49 ***
Quadratic	1	12.68 ***	10.74 **	14.88 ***
Remainder df	879			
Remainder mean squares		168577714.09	130731603.2	105477789.90
iii Lifetime days in milk				
Sire	138	1.20 *	1.11 ns	1.11 ns
Year of birth(Y)	1	1.24 ns	0.01 ns	0.04 ns
Season of birth(S)	3	2.59 *	2.88 *	2.87 *
Y x S interaction	3	4.79 **	5.12 **	5.09 ***
Regression on age at first calving				
Linear	1	1.56 ns	3.15 *	3.23 *
Quadratic	1	0.78 ns	0.78 ns	0.78 ns
Regression on first lactation 305- day milk yield				
Linear	1	13.44 ***	7.71 **	7.89 **
Quadratic	1	10.36 **	6.92 **	7.16 **
Remainder df	879			
Remainder mean squares		681337.42	555414.45	785570.18

Table 16 . Cont'd

Independent Variable	N	Milk yield per day of productive life(kg)			Milk yield per day of herd life (kg)		
		Data uncorrected	Data corrected using ACFs+	Data corrected using MCFs++	Data uncorrected	Data corrected using ACFs+	Data Corrected using MCFs++
Year of birth(Y)							
1981	372	15±0.17	14±0.17	14±0.16	12±0.19	10±0.14	10±0.13
1983	657	14±0.14	15±0.14	14±0.13	11±0.16	11±0.11	11±0.11
Season of birth(S)							
Winter	170	15±0.20	14±0.20	14±0.19	11±0.21	11±0.17	10±0.15
Spring	317	15±0.15	15±0.15	14±0.14	12±0.16	11±0.12	11±0.12
Summer	257	15±0.17	14±0.16	14±0.15	11±0.18	11±0.14	11±0.13
Autumn	285	14±0.20	14±0.20	14±0.19	11±0.22	11±0.17	11±0.16
Y x S interaction							
Winter-1981	47	15±0.31	14±0.31	14±0.30	12±0.33	11±0.27	10±0.24
Spring –1981	190	16±0.18	14±0.18	14±0.17	12±0.20	11±0.16	10±0.14
Summer-1981	95	15±0.24	14±0.24	14±0.23	11±0.26	10±0.21	10±0.19
Autumn-1981	40	15±0.35	14±0.35	14±0.34	11±0.37	10±0.31	10±0.27
Winter-1983	123	14±0.23	14±0.22	14±0.21	10±0.24	11±0.19	11±0.17
Spring-1983	127	14±0.23	14±0.22	14±0.21	11±0.24	11±0.19	11±0.18
Summer-1983	162	14±0.20	14±0.20	14±0 19	11±0.22	11±0.17	11±0.16
Autumn-1983	245	14±0.18	15±0.17	14±0.16	11±0.19	12±0.15	11±0.14
Regression on age at first calving							
Linear	1029	0.003± 0.05	0.033±0.05	-0.146±0.045	-0.18±0.05	-0.16±0.04	-0.28±0.02
Quadratic	1029	-0.008±0.01	-0.01±0.02	-0.001±0.00	-0.009±0.02	-0.006±0.01	-0.008±0.015
Regression on first 305 day milk yield							
Linear	1029	0.002± 0.00	0.001±0.00	00.0±0.00	0.002±0.00	0.001±0.00	0.001±0.00
Quadratic	1029	0.00± 0.00	0.00 ± 0.00	00.0±0.00	0.00±0.00	0.00 ±0.00	0.00 ±0.00

+ = additive correction factors

++ = multiplicative correction factoros obtained using polynomial regression .

using multiplicative correction factors which proved nonsignificant .

The highest means were recorded by cows born in summer and autumn ,1983 . The significant interaction between year of birth and season of birth indicate that the effect of season of birth differed with the change of year of birth .

4.1.3.5 Age at first calving effect .

Age of the cow at first calving contributed significantly ($p < 0.05$, $p < 0.01$ or $p < 0.001$) to the variance of most lifetime milk production traits of the study when using any of the three types of data (Table 15) . In this respect , **Hargrove *et al* (1969)** with Holstein Friesian cattle reported that age at first calving effect on lifetime days in milk was significant ($p < 0.01$) . The same effect on either lifetime total milk yield or milk yield per day of productive life was indicated to be significant ($p < 0.01$) by **Sultan and Khattab (1989)** . They found that the partial linear regression coefficients of both up-mentioned lifetime milk production traits on age at first calving were significant ($p < 0.01$) . Also , **Roy and Tripathi (1990)** proved that the effect of age at first calving on lifetime milk production , milk yield per day of productive life and milk yield per day of herd life was significant ($p < 0.01$) through studying the regression coeffecients of these three traits on age at first calving . All these findings when coupled with those of the present findings would refer to the importance of age at first calving in influencing lifetime milk production traits .

Partial linear regression coefficients of lifetime milk production traits of the study on age at first calving were negative except that of milk yield per day of productive life when analyzing milk production uncorrected milk production data and milk production data corrected by the additive correction factors (Table 16) . Results in the same table indicate that most of the quadratic regression coefficients of lifetime milk production traits were also negative . These findings would lead to state that lifetime milk production traits in the herd of the study were negatively associated with age of cows at first calving , and this means that the performance of milk production traits increased as age at first calving decreased within the range of the breed (Holstein Friesian) . Similarly , **Hargrove *et al* (1969)** with animals of the same breed observed that age of the cow at first calving was negatively correlated with lifetime days in milk . Also , **Gill and Allaire (1976)** found that age at first calving was negatively phenotypically and genetically correlated with lifetime milk yield and noted that early first calvers were more economic producers than later first calvers . Similarly, **Lin and Allaire (1978)** reported that the phenotypic and genetic cerrelation coefficients between age at first calving and lifetime milk yield were negative . In conclusion , it could be stated that younger first calvers had , in general , higher lifetime milk production traits than older first calvers .

4.1.3.6 First lactation milk yield effect .

First lactation 305-day milk yield was found to have significant ($p< 0.05$,$p< 0.01$,or $p< 0.001$) influence on all lifetime milk production traits of the study when analyzing either milk production uncorrected or corrected data (Table15). In consistent with this observation ,results of **White and Nichols (1965)** on Holstein Friesian cattle showed that cows with higher first lactation milk yield produced significantly ($p< 0.01$) more milk in later life than those with lower first lactation milk yield . Also , results of **Hargrove *et al* (1969)** gave evidence through the regression analysis that first lactation milk yield contributed significantly ($p< 0.01$) to the variance of lifetime total milk yield .

F-values of the linear and quadratic regression coefficients of milk production traits when analyzing uncorrected and corrected data when compared to those of other non-genetic factors included in the model of analysis would indicate that the effect of first lactation milk yield was the most important non-genetic factor influenceing lifetime milk production traits of the study . Results of the present study and those of the cited literature would refer to the relative major importance of first lactation milk yield in influenceing lifetime milk production.

Results listed in table 15 and 16 indicate that there was significant positive association between first 305-days milk yield and each of the lifetime milk production traits since all linear regression coefficients were positive and at the same time all the quadratic regression coefficients amounted to zero . These findings proved that as the first 305-days milk yield in the herd of the study increased the performance of cows for lifetime milk production traits increased . In accordance with these findings , **Van Vleck (1964) and White and Nichols (1965)** evidenced that cows with higher first lactation milk yield recorded higher lifetime milk yield than those with lower first lactation milk yield . **Hargrove *et al* (1969)** reported a strong positive association between first lactation milk yield and lifetime milk yield (rp =0.45 and rg =0.85) . Also ,results of **Van Vleck (1964) ,White and Nichols (1965) and Mokhtar et al (1985)** showed that higher milk producers in the first lactation continued at higher level of milk production than lower first lactation producers .**The same authors (1985)** proved that higher level of lifetime milk production traits appeared to have close relationship with higher level of first lactation milk production . The magnitude of sire heritability of first lactation milk yield was found to be moderate (0.39 , 0.22 and 0.38)by **Hargrove *et al* (1969) ; Hoque and Hodges (1980) and Jadhav and Khan (1995)** , respectively or high (0.48 and 0.64) by **Sultan and Khattab (1989) and Khattab *et al* (1994)** . Results of the present study , of the up-mentioned literature in addition to those of **Hinks (1966) Gilmore ; (1977) , Hoque and Hodges (1980) and Burnside *et al* (1984)** lead to state that selection for higher first lactation milk yield is deemed to be accompanied by an increase in lifetime milk production. **Hoque and Hodges (1980)** noted that continued selection for first lactation milk yield is an effective means to maximize lifetime milk production .

4.2 Genetic Aspects

4.2.1 Sire effect

Results of the effect of sire on age at first calving in addition to longevity traits (age at last calving , length of productive life , length of herd life and number of lactations completed) and lifetime milk production traits (lifetime 305-day milk yield , lifetime total milk yield , lifetime days in milk , milk yield per day of lifetime days in milk , milk yield per day of productive life and milk yield per day of herd life) are presented in tables 8 , 11 and 15 , respectively . These results proved that sire effect was significant ($p < 0.05$, $p < 0.01$ or $p < 0.001$) on age at first calving , all longevity traits of the study , lifetime 305-day milk yield , lifetime total milk yield , milk yield per day of productive life and milk yield per day of herd life . These results are in agreement with those of **Harville and Henderson (1966)** , **Sharaby and El-Kimary (1982)** , **Khattab and Sultan (1990 a & b)** and **Mokhtar et al (1993)** who found that the effect of sire on age at first calving was significant ($p < 0.01$ or $p < 0.001$) . Similarly , **Sultan and Khattab (1989)** gave evidence that the effect of sire on herd life and milk yield per day of herd life was significant ($p < 0.01$).

4.2.2 Sire component of variance .

Sire component of variance was 0.24 for age at first calving (Table 17) , 26.22 , 29.16 and 29.16 for age at last calving , productive life (in months) and length of herd life (in months) , respectively

Table 17 Estimates of variance components, percentages of variation (V%) and heritability for age at first calving.

Item	Estimate
Sire variance component	0.24
Percentage of vartiation (V%)	9.48
Remainder variance component	2.26
Percentage of vartiation (V%)	90.52
Heritability estimate	0.38 ± 0.10
Number of records used	1029

while was 0.09 for number of lactations completed (Table 18). The estimate of this component ranged from 2208724 to 6952574 for lifetime 305-day milk yield and lifetime total milk yield (in kilograms) , from 8176 to 18643 for lifetime days in milk , from 0.041 to 0.217 for milk yield per day of lifetime days in milk , milk yield per day of productive life and milk yield per day of herd life (Table 19).

Sire effect was responsible for 9.48 % of the total variance in age at first calving from 4.63 to 5.10 % of the total variance in all longevity traits of the study and from 0.68 to 5.21 % of the total variance in lifetime milk production traits (Tables 17 , 18 and 19). The contribution of the sire effect was moderatly low for age at first calving but only low for longevity and lifetime milk production traits . The low contribution of the sire effect in the up-mentioned traits (age at first calving and each of longevity and milk production traits) might be attributed to that these traits are generally greatly influenced by non-genetic factors and this is clear when bearing in mind the

Table 18 Estimates of variance components , percentages of variation (V%) and Heritability (h^2) for longevity traits in Holstein Friesian cattle

Trait	Sire Component	V%	Remainder component	V%	h^2	SE
Age at last calving	26.22	5.10	487.72	94.90	0.20	0.09
Productive life						
in month	29.16	5.10	543.07	94.90	0.20	0.09
in days	26241.25	5.10	488761.32	94.90	0.20	0.09
Herd life						
in month	29.16	5.10	543.07	94.90	0.20	0.09
in days	26241.25	5.10	488761.32	94.90	0.20	0.09
Number lactations completed	00.09	4.63	1.89	95.37	0.19	0.09

Table 19 Estimates of variance components, percentages of variation (V%) and heritability (h^2) ± SE for lifetime productive(milk production) traits in Holstein Friesian cattle using uncorrected and corrected data .

Traits	Sire component	V%	Remainder component	V%	h^2	SE
Using uncorrected data						
Life time 305-day milk yield	3003778	3.21	9045136	96.78	0.129	0.083
Life time total milk yield	6952574	3.96	168577714	96.04	0.158	0.850
Life time days in milk	18643	2.66	681337	97.34	0.107	0.081
Milk yield per day of lifetime days in milk	0.062	0.68	9.08	99.32	0.027	0.740
Milk yield per day of productive life	0.146	3.79	3.70	96.20	0.152	0.085
milk yield per day of herd life	0.217	5.21	3.95	94.79	0.208	0.089
Using data corrected by additive correction factors						
Life time 305-day milk yield	3457164	3.72	89394004	96.20	0.149	0.085
Life time total milk yield	5225794	3.84	130731603	96.17	0.154	0.085
Life time days in milk	8176	1.45	555414	98.55	0.058	0.077
Average milk yield per day of lifetime days in milk	0.175	1.89	9.07	98.16	0.076	0.078
Average milk yield per day of productive life	0.102	2.65	3.75	97.40	0.106	0.081
milk yield per day of herd life	0.044	1.48	2.93	98.65	0.059	0.077
Using data corrected by multiplicative correction factor						
Life time 305-day milk yield	2208724	4.62	45618168	95.38	0.185	0.088
Life time total milk yield	5510404	4.96	105477790	95.04	0.199	0.089
Life time per day of lifetime days in milk	11738	1.47	785570	98.53	0.059	0.077
Average milk yield per day of lactation	0.165	2.11	7.71	97.84	0.084	0.079
Average milk yield per day of productive life	0.090	2.57	3.41	97.43	0.103	0.081
Milk yield per day of herd life	0.089	3.92	2.18	96.04	0.157	0.085

percentages of the remainder components of variance (Tables 17 , 18 and 19) .

4.2.3 Sire heritability estimates

The sire heritability estimate was moderate for age at first calving (0.38 ± 0.10) , generally moderate for longevity traits (0.19 – 0.20) and ranged from low to moderate for lifetime milk production traits (0.027 – 0.208) .

Sire heritability estimate obrained for age at first calving in Holstein Friesian cattle in the present study (0.38 ± 0.10) and that for the same trait (0.41)in animals of the same breed by **Managukar *et al* (1984)** are of highly moderate magnitudes . These findings and those of the linear and / or quadratic regression coefficients of longevity traits on age at first calving in either the present study or in the cited available literature **(Sultan and Khattab , 1989)** would lead to state that individual selection for early age at first calving (within the range of that age determined for the breed) would bring about considerable increase in the performance of dairy cows for longevity traits .

Sire heritability magnitude evaluated in the present work was 0.20 for age at last calving , .020 for length of productive life , 0.20 for herd life and 0.19 for number of lactations completed during the cow`s productive life (Table 18) . Heritability estimate calculated for age at last calving in this work (0.20) is a little bit higher than that calculated by the same method (paternal half-sib analysis) for the same trait by **Parker** ***et al*** **(1960)** which accounted for 0.19 and higher than the sire heritability given by **White and Nichols (1965)** which was 0.14 . Also , the sire heritability estimated for length of productive life (0.20) illustrated in table 18 is higher than the corresponding estimate reached for the same trait by **Hoque and Hodges (1980)** which accounted for 0.10 ± 0.01 in Holstein Friesian cattle . At the same time sire heritability value for herd life (0.20) as shown in table 18 is also higher than that calculated by **Hoque and Hodges (1980)** which was 0.10 ± 0.01 . The same result was detected when comparing sire hertibility estimated in the present study with those of **White and Nichols (1965) , Miller et al (1967) and Hoque and Hodges (1980)** for number of lactations completed (0.20 vs 0.13 , 0.05 and 0.09 ; respectively) . Estimates of the present study indicate that longevity traits of the study were moderately heritable .

Values of sire heritability for lifetime milk production traits were mostly low (Table 19) . When using the uncorrected data , these values were found to be 0.129 , 0.158 and 0.152 for lifetime 305-day milk yield , lifetime total milk yield and milk yield per day of productive life , respectively . The corresponding values were 0.149 , 0.154 and 0.106 when using milk production data corrected by the additive correction factors while were 0.185 , 0.199 and 0.103 when utilyzing milk production data corrected by the multiplicative correction factors .

4.1.3.7 Phenotypic and genetic correlation coefficients .

The phenotypic correlation coefficients among longevity traits (0.968 – 1.000) and among lifetime milk production traits (0.343 – 0.793) in addition to those between longevity and lifetime milk production traits in all possible combinations (0.343 – 0.901) when using the milk production uncorrected data were mostly positive , significant and strong (Table 20) . The corresponding genetic correlation coefficients (Table 21) exhibited the same picture but were higher in magnitudes than the phenotypic correlation coefficients. The same trends of both phenotypic and genetic correlation coefficients were generally re-exhibited when using milk production corrected data by either additive or multiplicative correction factors (Tables 22 ,23 24 , 25) .

In this concern , the literature cited on Holstein Friesian cattle revealed that the phenotypic correlation coefficients among longevity traits varied from 0.970 to more than 0.995 but less than unity (**Hargrove , 1969 ; Hoque and Hodges ; 1980)** , between longevity traits and lifetime milk production traits in all posible combinations differed in most from 0.95 to 0.99 and among lifetime milk production traits ranged from 0.97 to 0.99 . For Friesian cattle the corresponding ranges of these phenotypic correlation coefficients were 0.52 – 0.77 , 0.20 – 0.92 and 0.54 - 0.58 **(Sultan and Khattab , 1989 ; Khattab *et al* , 1994) .** The genetic correlation coefficients (calculated through paternal half-sib analysis) among longevity traits , between longevity traits and lifetime milk production traits and among lifetime

Table 20 Phenotypic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using uncorrected data of milk production traits.

	Age at last calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life (kg)	Milk yield / day of lifetime days in milk (kg)
Age at last calving										
Number of lctations completed	0.969**									
Herd life (month)	0.998**	0.968**								
Productive life (month)	0.998**	0.968**	1.000**							
Lifetime 305-day milk yield (kg)	0.914**	0.949**	0.913**	0.913**						
Lifetime total milk yield (kg)	0.938**	0.944**	0.941**	0.941**	0.984**					
Lifetime days in milk	0.695**	0.690**	0.699**	0.699**	0.658**	0.685**				
Milk yield/day of herd life(kg)	0.737**	0.793**	0.743**	0.743**	0.901**	0.895**	0.567**			
Milk yield/day of productive life (kg)	0.398**	0.482**	0.404**	0.404**	0.667**	0.651**	0.343**	0.877**		
Milk yield / day of lifetime days in milk (kg)	0.372**	0.401**	0.373**	0.373**	0.526**	0.502**	-0.215**	0.605**	0.607**	

Table 21 Genetic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using uncorrected data of milk production traits.

	Age at last calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life (kg)
Age at last calving									
Number of lactations completed	0.996±0.012								
Herd life (month)	1.000±0.001	1.002±0.012							
Productive life (month)	1.000±0.001	1.002±0.012	1.000±0.000						
Lifetime 305-day milk yield (kg)	0.958±0.054	0.979±0.033	0.953±0.055	0.953±0.055					
Lifetime total milk yield (kg)	0.953±0.038	0.973±0.030	0.949±0.038	0.949±0.038	0.997±0.011				
Lifetime days in milk	1.099±0.189	1.152±0.204	1.111±0.190	1.111±0.190	1.278±0.276	1.231±0.233			
Milk yield/day of herd life(kg)	0.974±0.094	1.000±0.077	0.971±0.092	0.971±0.092	1.073±0.071	1.046±0.049	1.238±0.281		
Milk yield/day of productive life(kg)	0.836±0.251	0.853±0.229	0.830±0.250	0.830±0.250	1.071±0.177	1.036±0.163	1.241±0.422	0.935±0.065	
Milk yield / day of days in milk (kg)	1.354±1.547	1.355±1.516	1.307±1.490	1.307±1.490	1.299±1.293	1.250±1.279	2.052±3.216	1.195±1.147	0.978±0.86

Table 22 Phenotypic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using corrected data of milk production traits by additive correction factors.

	Age at last Calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in Milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life (kg)
Age at last calving									
Number of lctations completed	0.969**								
Herd life (month)	0.998**	0.968**							
Productive life (month)	0.998**	0.968**	1.000**						
Lifetime 305-day milk yield (kg)	0.917**	0.945**	0.917**	0.917**					
Lifetime total milk yield (kg)	0.915**	0.940**	0.915**	0.915**	0.996**				
Lifetime days in milk	0.629**	0.648**	0.630**	0.630**	0.618**	0.622**			
Milk yield/day of herd life(kg)	0.569**	0.668**	0.569**	0.569**	0.822**	0.828**	0.440**		
Milk yield/day of productive life(kg)	-0.012ns	0.108**	-0.015ns	-0.015ns	0.346**	0.359**	0.090**	0.745**	
Milk yield / day of lifetime days in milk (kg)	0.365**	0.374**	0.367**	0.367**	0.527**	0.525**	-0.273**	0.590**	0.470**

Table 23 Genetic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using corrected data of milk production traits by additive correction factors.

	Age at last calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life (kg)
Age at last calving									
Number of lctations completed	0.996±0.012								
Herd life (month)	1.000±0.001	1.002±0.012							
Productive life (month)	1.000±0.001	1.002±0.012	1.000±0.000						
Lifetime 305-day milk yield (kg)	0.949±0.048	0.966±0.033	0.943±0.049	0.943±0.049					
Lifetime total milk yield (kg)	0.926±0.055	0.947±0.041	0.922±0.056	0.922±0.056	0.998±0.003				
Lifetime days in milk	1.174±0.457	1.251±0.483	1.194±0.467	1.194±0.467	1.369±0.564	1.354±0.552			
Milk yield/day of herd life(kg)	0.949±0.398	0.953±0.331	0.945±0.397	0.945±0.397	1.128±0.282	1.144±0.292	1.493±0.943		
Milk yield/day of productive life (kg)	-0.321±0.430	-0.343±0.422	-0.337±0.432	-0.337±0.432	-0.038±0.484	0.025±0 482	0.278±0.711	0.024±0.841	
Milk yield / day of lifetime days in milk (kg)	0.615±0.399	0.597±0.409	0.584±0.399	0.584±0.399	0.680±0.363	0.683±0.360	0.984±1.383	0.926±0.446	0.127±0.632

Table 24 Phenotypic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using corrected data of milk production traits by multiplicative correction factors obtained through polynomial regression.

	Age at last calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life (kg)
Age at last calving									
Number of lactations completed	0.969**								
Herd life (month)	0.998**	0.968**							
Productive life (month)	0.998**	0.968**	1.000**						
Lifetime 305-day milk yield (kg)	0.909**	0.936**	0.909**	0.909**					
Lifetime total milk yield (kg)	0.914**	0.937**	0.915**	0.915**	0.996**				
Lifetime days in milk	0.630**	0.650**	0.631**	0.631**	0.609**	0.618**			
Milk yield/day of herd life(kg)	0.469**	0.571**	0.470**	0.470**	0.760**	0.758**	0.369**		
Milk yield/day of productive life(kg)	-0.188**	-0.076*	-0.191**	-0.191**	0.188**	0.186**	-0.042**	0.695**	
Milk yield / day of lifetime days in milk (kg)	-0.046ns	-0.004ns	-0.051ns	-0.051ns	-0.167**	0.182**	-0.542**	0.448**	0.551**

Table 25 Genetic correlation coefficients among longevity and milk production traits in Holstein Friesian cattle using corrected data of milk production traits by multiplicative correction factors obtained through polynomial regression.

	Age at last calving	Number of lactations completed	Herd life (month)	Productive life (month)	Lifetime 305-day milk yield (kg)	Lifetime total milk yield (kg)	Lifetime days in milk	Milk yield /day of herd life(kg)	Milk yield / day of productive life(kg)
Age at last calving									
Number of lctations completed	0.996±0.012								
Herd life (month)	1.000±0.001	1.002±0.012							
Productive life (month)	1.000±0.001	1.002±0.012	1.000±0.000						
Lifetime 305-day milk yield (kg)	0.921±0.053	0.938±0.042	0.917±0.055	0.917±0.055					
Lifetime total milk yield (kg)	0.934±0.046	0.948±0.037	0.932±0.046	0.932±0.046	0.996±0.003				
Lifetime days in milk	1.165±0.441	1.238±0.466	1.185±0.454	1.185±0.454	1.236±0.490	1.242±0.491			
Milk yield/day of herd life(kg)	0.977±0.217	0.973±0.183	0.974±0.216	0.974±0.216	1.130±0.115	1.092±0.107	1.279±0.676		
Milk yield/day of productive life(kg)	0.200±0.456	-0.218±0.457	-0.212±0.459	-0.212±0.459	0.170±0.426	0.125±0.418	0.253±0.755	0.152±0.477	
Milk yield / day of lifetime days in milk (kg)	-0.178±0.474	-0.215±0.487	-0.212±0.479	-0.212±0.479	0.063±0.478	0.001±0.472	-0.254±1.062	0.201±0.482	0.397±0.493

milk production traits calculated by the paternal half-sib analysis method exceeded , in general , the corresponding phenotypic correlation coefficients (Tables 20, 21, 22, 23, 24, 25) . This appears to be in agreement with the results of the literature cited . Results of the present work and those of the reviewed literature indicate the presence of either moderate or strong positive phenotypic and genetic correlation coefficients among longevity traits , between longevity and lifetime milk production traits and among lifetime milk production traits . The strong genetic correlation coefficients among longevity and lifetime milk production traits in all possible combinations would lead to suggest that the performance of any of these traits adequately measures the performance of the cow for any of lifetime traits . This was supported by **Hoque and Hodges (1980) .** Thus , selection for any of the longevity traits (moderately heritable) would result in improvement of all lifetime traits .