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# Relationships of Early Performance Traits with Longevity and Lifetime Traits in Friesian Cattle under Egyptian Conditions

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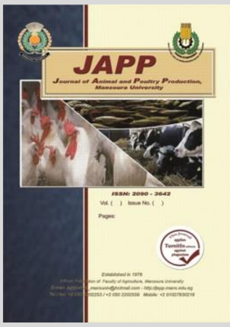


## ABSTRACT

The purpose of the study was to determine the association between each of heifer and first lactation traits with each of longevity and lifetime production traits of 2914 Friesian cows from 1979 to 2013. Correlations between each of heifer and first lactation traits and each of longevity and lifetime production traits were estimated. Genetic correlations between both LLNO and PL and each of AFB, ASB and AFC were strong negative, however, correlations between HL and same heifer traits were strong positive. Strong negative genetic relationships between NSC0 and each of LLNO, HL and PL, however, correlations between each of CR0 and SP0 and each of LLNO, HL and PL were strong positive. Genetic correlations between age traits and each of lifetime production traits were positive. Genetic relationships between first lactation fertility traits and all longevity traits were strong negative, however the genetic correlations between first lactation production traits and longevity traits were strong positive. Medium to high genetic relationships between first lactation fertility traits and lifetime traits were obtained. Genetic relationships between first lactation production traits and lifetime production traits were strong positive.

***Keywords:*** longevity, lifetime, heifers, first lactation, correlation, Friesian.

## INTRODUCTION

Functional longevity (i.e., overall fitness of cow) have received great attention in improving programs for dairy cattle in many countries (Zavadilova and Stipkova, 2013). The correlation of longevity with animal health makes longevity a high desirable trait in dairy production. Relationships between traits of first lactation and length of herd life were examined by many authors (Zahed, 2004; and Sadek *et al*., 2009, VanRaden *et al*., 2004). Age at first calving (AFC) has been associated with longevity and also has a direct effect on economic return of dairy farms (Eastham, *et al*., 2018). Decreasing AFC has a positive genetic effect due to decreasing the generation interval, and also reducing both heifers rearing costs and replacement costs of culled animals (Gardner *et al*., 1988, Pirlo *et al*., 2000 and Nilforooshan and Edriss, 2004).

To maximize dairy farm profitability, average AFC in Holsteins was recommended to be ≤24 (Tozer and Heinrichs, 2001, and Cocke, *et al*., 2013). Late calving are presumably caused by reasons related to reproductive disorders, herd management, or other health problems, so such factors increased culling risk (Vukasinovic *et al*., 2001; Sewalem *et al*., 2005). During the last decades, average AFC has not reduced much because of the belief that early calving is harmful to milk production and lifetime production traits (Pirlo *et al*., 2000). Calving too early may be correlated with an increased risk of dystocia (Hofman, 1997), as well as harmful effect on economic productivity return (Ettema and Santos, 2004).

Heifer rearing costs represent the second largest expense after feed on, a dairy farm accounting for approximately 20% (Jenko *et al*., 2015 and Boulton, *et al*., 2015). It is desirable to stay cows in a herd for a long time, to decrease the heifer rearing costs and to have a high level of milk production. Although lifetime milk production yield (LMY) is one of the most important traits, direct selection for a high LMY is usually not performed in dairy cattle breeding programes due to the time elapsed between sire's birth and the time of selection, so one of possible solution would be through the selection of genetically strong correlated traits in early age of animals (Jenko *et al*., 2015).

The purpose of the study was to estimate correlations between each of heifer and first lactation traits with both longevity and lifetime production traits.

## MATERIALS AND METHODS

Heifer, first lactation, longevity and lifetime production records were provided by Animal Production Research Institute (APRI), Ministry of Agriculture and Land Reclamation, Dokki, Giza, Egypt. Records with missing identification of sire, incorrect calving dates, or AFC outside the range of 16-42 months were excluded leaving the data set of 2914 cows.

In the present study considered traits, were heifer fertility traits expressed as: age at first breeding (AFB) i.e., time between birth date and first service date in days; age at successful breeding (ASB), i.e., time in days between birth date and conception date; age at first calving (AFC), i.e., time between birth date and first calving date in days; number of services per conception (NSC0); conception rate (CR0 = (1/NSC0)*100) and service period (SP0), i.e., time in days between first service date and conception date. First lactation traits expressed as: number of services per conception (NSC1), conception rate (CR1= (1/NSC1)*100); calving to first service (CFS1) i.e., time in

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days between calving date and first service date; service period (SP1), i.e., time in days between first service date and conception date; days open (DO1), i.e., time in days between calving date and conception date; 305-day milk yield in Kg (M3051), total milk yield in Kg (TMY1); lactation period (LP1), i.e., time in days between three days after calving date and dry date and daily milk yield in Kg (DMY1 = TMY1/LP1). Longevity traits were number of lactation completed (LLNO); herd life (HL), i.e., time in days elapsed between birth date and culling/death date; productive life (PL), time in days elapsed between date of first calving and culling/death date and total days in lactation over all lactations (LLP). Lifetime production traits were 305-day milk yield (LM305), i.e., accumulation of 305-day milk yield in Kg of individual lactation for individual cow; total milk yield (LTMY) , i.e., accumulation of individual lactation total milk yield in Kg of individual cow; average of lifetime total milk yield per day of herd life (LMYHL), i.e., LTMY/HL, Kg.; average of lifetime total milk yield per day of lactation period (LMYLP), i.e., LTMY/LP, Kg. and longevity index (LLPHL), i.e., ((LLP/HL)*100).

Different non-genetic effects affecting heifers, first lactation, longevity and lifetime production traits were accounted (Table 1) using GLM procedure of SAS (2011). AFB classes every three months were 12-, 15-, 18, 21, 24-, 27- and 30-32 months. AFC classes every three months were, <23, 23-, 26-, 29-, 32-, 35- and 38-42 months. Nine first lactation service period classes were zero service period, <21, 22-43, 44-65, 66-87, 88-109, 110-131, 132-153, and >153 day. Nine lactation period of first lactation were 150-180, 181-211, 212-242, 243-273, 274-304, 305-335, 336-366, 367-397 and >397 day, and ten lifetime lactation number. Genetic and phenotypic parameters were estimated using VCE6 program (Groeneveld *et al*., 2010) after incorporating animal and error as random effects and fixed effect as shown in table 1, in the model. Pedigree file was included to estimate EBV by using PEST program (Groeneveld *et al*., 2001), fitting multi-trait animal model.

**Table 1. Statistical model summary[a] of heifer, first lactation, longevity and lifetime production traits**.

| **Trait[b]** | **F** | **M1s** | **Y1s** | **FMY1s** | **AFBc** | **NSC** | | | **Model No.** |
|---|---|---|---|---|---|---|---|---|---|
| **Heifer traits** | | | | | | | | | |
| AFB | X | X | X | X | | | | | 1 |
| NSC0, ASB, AFC | X | X | X | X | X | | | | 2 |
| CR0, SP0 | X | X | X | X | X | X | | | 3 |
| First lactation traits | | | | | | | | | |
| Trait[b] | F | M1c | Y1c | FMY1c | AFCc | NSC | DO | LP | Model No. |
| NSC1, CFS1 | X | X | X | X | X | | | | 4 |
| CR1, SP1, DO1 | X | X | X | X | X | X | | | 5 |
| LP1, DMY1 | X | X | X | X | X | | X | | 6 |
| M305, TMY1 | X | X | X | X | X | | X | X | 7 |
| Longevity and lifetime production traits | | | | | | | | | |
| Trait[b] | F | M1c | Y1c | AFCc | SP1c | LP1c | LLNo | | Model No. |
| LLNO | X | X | X | X | | X | | | 8 |
| LM305 | X | X | X | X | | X | X | | 9 |
| LLP, HL, PL, LTMY, LMYHL, LMYLP, LPHL | X | X | X | X | X | X | X | | 10 |

**a: F: farm, M1s: month of first breeding, Y1s: year of fist breeding, FMY1s: farm-month-year of first breeding, AFBc: age at first breeding classes, NSC: number of service per conception, M1c : month of first calving, Y1c: year of fist calving, FMY1c: farm-month-year of first calving, AFCc: age at first calving classes, DO: days open as a covariate, LP: lactation period as a covariate, SP1c: first lactation service period classes, LP1c: lactation period classes of first lactation, LLNo: lifetime lactation number,**
**b: AFB: age at first breeding, ASB: age at successful breeding, AFC: age at first calving, NSC0: number of services per conception for heifer, CR0: conception rate for heifer, SP0: service period for heifer, NSC1: number of services per conception for cow, CR1: conception rate for cow, CFS1: calving to first service for cow, SP1: service period for cow, DO1: days open for cow, LP1: lactation period for cow, DMY1: daily milk yield for cow, M305: 305-day milk yield for cow, TMY1: total milk yield for cow. LLNo: lifetime lactation number, LM305: lifetime 305-day milk yield, LTMY: lifetime total milk yield, LLP: lifetime lactation period, HL: herd life, PL: productive life, LMYHL: lifetime daily milk yield per day of herd life, LMYLP: lifetime daily milk yield per day of lactation period, and LLPHL: longevity index.**

## RESULTS AND DISCUSSION

### Genetic and Phenotypic Correlations

### Heifer and both longevity and lifetime production traits

Table (2) shows estimates of genetic correlations between heifer traits and each of longevity and lifetime production traits. LLNO had strong negative genetic correlations with each of AFB, ASB and AFC (-0.947, -0.995 and 0.-999, respectively), as well as the relationship between PL with the same traits (-0.972, -0.942 and -0.961, respectively, table 2), indicating that starting heifer to breed, to conceive or to calve at an earlier age will increase both LLNO and PL. In contrast, genetic correlations between HL and each of AFB, ASB and AFC were positive and high (0.995, 0.991 and 0.985, respectively) as well as the relationship between LLP with the same heifer traits (0.976, 0.832 and 0.912, respectively, table 2), meaning that older heifers at first service, at successful service or at first calving will increase both HL and LLP (Table 2). Relationships between AFB, ASB and AFC with lifetime production traits were positive medium and ranged from 0.717 between ASB and LTMY to 0.877 between AFC and LMYHL (Table 2).

Negative strong genetic correlations between NSC0 and each of LLNO, HL, PL and LLP (-0.947, -0.939, -0.942 and -0.926, respectively, table 2), indicate that increasing NSC0 will decrease cow longevity traits. The same trend was observed for CR0. The relationship between SP0 and longevity traits (LLNO, HL, PL and LLP) were strong positive (0.923, 0.970, 0.996 and 0.983, respectively) as shown in Table 2.

Genetic correlations between NSC0 and lifetime production traits were positive and ranged from 0.709 between NSC0 and LM305 to 0.895 between NSC0 and LLPHL. Genetic relationships between CR0 and all lifetime production traits were negative and ranged from -0.834 between CR0 and LLPHL, to -0.948 between CR0 and LM305 (Table 2), indicate that increasing CR0 will decrease all lifetime production traits. SP0 has medium negative genetic correlation with LM305 (-0.815) and LTMY (-0.822), however it was medium positive with each of LMYHL, LMYPL and LLPHL (0.893, 0.873 and 0.873, respectively, table 2). Ajili *et al*., (2007) found that age at first calving (AFC) effect on productive life was highly significant (P<0.01) and an age between 23-27 months seemed to be an optimum AFC for increased productive life. Negative genetic relationships between AFC and longevity traits found in the present study were in agreement with Zahed, (2004), Hoque and Hodges, (1980), and Ashmawy, (1985). Zahed (2004) reported that genetic correlations between AFC and longevity traits (LLNO, HL, PL and LLP) were -0.98, -0.98, -0.96 and, -1.00, respectively, while between AFC with lifetime production traits (LM305 and LTMY) were -0.70 and -0.82, respectively.

**Table 2. Genetic Correlation of Heifers and each of Longevity and lifetime production traits**

| Heifer traits[a] | Longevity traits[b] | | | | Lifetime production traits[b] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LLNo | HL | PL | LLP | LM305 | LTMY | LMYHL | LMYLP | LLPHL |
| AFB | -0.947 | 0.995 | -0.972 | 0.976 | 0.781 | 0.771 | 0.807 | 0.798 | 0.848 |
| ASB | -0.995 | 0.991 | -0.942 | 0.832 | 0.719 | 0.717 | 0.836 | 0.787 | 0.859 |
| AFC | -0.999 | 0.985 | -0.961 | 0.912 | 0.793 | 0.846 | 0.877 | 0.774 | 0.811 |
| NSC0 | -0.947 | -0.939 | -0.942 | -0.926 | 0.709 | 0.823 | 0.810 | 0.759 | 0.895 |
| CR0 | -0.960 | -0.943 | -0.962 | -0.952 | -0.948 | -0.844 | -0.941 | -0.902 | -0.834 |
| SP0 | 0.923 | 0.970 | 0.996 | 0.983 | -0.815 | -0.822 | 0.893 | 0.873 | 0.873 |

**a: AFB: age at first breeding, ASB: age at successful breeding, AFC: age at first calving, NSC0: number of services per conception for heifer, CR0: conception rate for heifer, SP0: service period for heifer,**
**b: LLNo: lifetime lactation number, HL: herd life, PL: productive life, LLP: lifetime lactation period, LM305: lifetime 305-day milk yield, LTMY: lifetime total milk yield, LMYHL: lifetime daily milk yield per day of herd life, LMYLP: lifetime daily milk yield per day of lactation period, and LLPHL: longevity index.**

Phenotypic correlations of heifer traits and each of longevity and lifetime traits were lower than genetic correlations and take the same trend (Table 3). Phenotypic correlations between LLNO and each of AFB, ASB and AFC were negative (-0.433, -0.570 and -0.650, respectively), as well as correlations between PL and the same traits (-0.775, -0.791 and -0.809, respectively, table 3). In contrast, positive medium phenotypic relationships between HL and each of AFB, ASB and AFC (0.784, 0.791 and 0.807, respectively, table 3). The same trend was found between LLP and the same traits (0.702, 0.727 and 0.787, respectively, table 3). Positive medium phenotypic correlations (0.653, 0.661, and 0.667) were found between LM305 and each of AFB, ASB and AFC, respectively, Table (3). The seam trend was found between each of LTMY and LMYLP with the same heifer traits (Table 3). However, negative medium relationships were found between LMYHL and the same three heifer traits (-0.668, -0.694 and -0.759, respectively) and between LLPHL with the same traits (-0.464, -0.605 and -0.627, respectively, table 3). Estimates of phenotypic correlations were positive medium (0.697, 0.700 and 0.694) between HL and both NSC0, CR0 and SP0, respectively (Table 3), however it was negative medium (0.697, 0.700 and 0.694) between PL and the traits (Table 3). NSC0 was negatively correlated with LM305, LTMY, LMYHL, LMYLP and LLPHL (0.580, 0.571, 0.564, 0.671 and 0.514, respectively, table 3). However CR0 was negatively correlated (-0.800, -0.697, -0.522, -0.789 and -0.843, respectively, table 3).

Nilforooshan and Edriss (2004) noted that as AFC increased, productive life decreased. This trend shows the importance of reducing AFC, which is supported by the negative phenotypic correlation (-0.093) between AFC and productive life (Nilforooshan and Edriss, 2004). Raheja (1994) reported that AFC) had negative phenotypic correlations with LLNO and LTMY. Teke and Murat (2013) concluded that AFC can affect LTMY, HL and PL and reducing the AFC is an effective for dairy farmers to decrease payments and allow an earlier return on investment. The same authors added that the optimum AFC for the maximum LTMY was 23 months.

**Table 3. Phenotypic Correlation of Heifers traits and each of Longevity and lifetime production traits**

| Heifer traits[a] | Longevity traits[b] | | | | Lifetime production traits[b] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LLNo | HL | PL | LLP | LM305 | LTMY | LMYHL | LMYLP | LLPHL |
| AFB | -0.433 | 0.784 | -0.775 | 0.702 | 0.653 | 0.625 | -0.668 | 0.571 | -0.464 |
| ASB | -0.570 | 0.791 | -0.791 | 0.727 | 0.661 | 0.638 | -0.694 | 0.600 | -0.605 |
| AFC | -0.650 | 0.807 | -0.809 | 0.787 | 0.667 | 0.657 | -0.759 | 0.629 | -0.627 |
| NSC0 | -0.736 | 0.697 | -0.617 | 0.879 | 0.580 | 0.571 | 0.564 | 0.671 | 0.514 |
| CR0 | 0.804 | 0.700 | -0.679 | 0.788 | -0.800 | -0.697 | -0.522 | -0.789 | -0.843 |
| SP0 | -0.818 | 0.694 | -0.710 | -0.713 | 0.608 | 0.627 | -0.556 | 0.592 | -0.706 |

**a: abbreviation as described in table 2, b: abbreviation as described in table 2.**

**First Lactation and both Longevity and Lifetime production traits**

Genetic correlations were -0.805, -0.880, -0.816 and -0.833 between NSC1 and each of LLNO, HL, PL and LLP, respectively (Table 4), indicate that increased number of services per conception, decreased all longevity traits. Sewalem *et al*., (2008) found that as number of services per conception (NSC1) increased the length of productive life decreased and relative risk of culling increased. The same trend was found for CR1. Genetic relationships between CR1 and each of LLNO, HL, PL and LLP were -0.848, -0.873, -0.830 and -0.820, respectively (Table 4). Genetic correlations were -0.873, -0.854, -0.849, and 0.840 between CFS1 and each of LLNO, HL, PL and LLP, respectively (Table 4), meaning that increase CFS1 will decrease longevity traits. Sewalem *et al*., (2008) reported that cows that were first inseminated 90 d or more after calving (CFS1) were at greater risk of being culling (i.e., short productive life length) compared with cows that have 61-90 d of CFS1.

Genetic relationship between SP1 and longevity traits (LLNO, HL, PL and LLP) were negative and ranged from -0.885 to -0.989 (Table 4), indicate that as SP1 increased, the longevity traits decreased. Sewalem *et al*., (2008) found that as service period (SP1) increased, the length of productive life decreased and the relative risk of culling of cows increased. The same trend was found for DO1 (i.e., as DO1 increased longevity traits decreased). Genetic correlations between traits of DO1 and longevity ranged from -0.908 to -0.981 (Table 4). Sewalem *et al*., (2008) reported that cows with fewer days open (DO1) than the breed average had longer survival (i.e., longer length of productive life) than did cows with the breed average days open. Genetic correlation between DO1 with PL was -0.59 indicating that fertility of cow plays a major role in longevity (VanRaden *et al*., 2004).

Genetic relationship between CR1 and each of LM305, LTMY LMYHL and LMTLP were negative strong (-0.825, -0.848, -0.843 and -0.864, respectively (Table 4). The same trend was found between each of SP1 and DO1 with most of lifetime production traits. Genetic correlations were -0.923, -0.905, -0.894 and -0.875 between SP1 and each of LM305, LTMY, LMYHL, and -0.875, respectively (Table 4). Genetic correlation between DO1 and each of LM305, LTMY, LMYHL and LLPHL were -0.984, -0.901 0.-837 and -0.823, respectively (Table 4). These results indicate that increasing first lactation service period or days open will decrease most of lifetime production traits. Genetic correlation between first lactation calving interval (CI1) with longevity traits were -0.61 for LLNO, -0.52 for HL,-0.45 for PL and -0.18 for LLP (Zahed, 2004). Genetic relationship between CI1 and each of LM305 and LTMY were -0.66 and -0.65, respectively (Zahed, 2004).

Genetic correlations between first lactation production traits (M3051, TMY1, LP1 and DMY1) and longevity traits (LLNO, HL, PL and LLP) were highly positive and ranged from 0.904 between LP1 and PL to 0.987 between M3051 and PL (Table 4). Genetic relationships between traits of first lactation production and lifetime production (LM305, LTMY, LMYHL, LMYLP and LLPHL) were highly positive and ranged from 0.900 between TMY1 and LPHL to 0.991 between M3051 and LM305 (Table 4). Selection on first lactation production traits seems to be most desirable for changing lifetime traits due to its high positive genetic relationship with total lifetime production (Hoque and Hodges, 1980 and Sadek *et al*., 2009). Tekerli and Kocak (2009) found that genetic correlations between TMY1 and each of HL and PL were 0.08 and 0.08, between LP1 and the same two traits were 0.10 and 0.107, however the correlation between CI1 with the same two traits were -0.22 and -0.21. Sadek *et al*., (2009) reported that genetic correlation between TMY1 and longevity traits (LTMY, LLNO, PL, HL and LLP) ranged from 0.20 between TMY1 and LLNO to 0.45 between TMY1 and LTMY. Genetic correlation between TMY1 and each of LTMY, LLNO, PL and HL ranged 0.41 - 0.56 (Hoque and Hodges, 1980). Valencia *et al*., (2002) found that estimates of genetic correlations between TMY1 and each of PL and LTMY until the third lactation were 0.33 and 0.64, respectively. The highly significant relationship between LLNO and TMY1 would lead to cow produce more offspring in the long length of herd life (Ashmawy, 1985). Jairath *et al*., (1995) reported that genetic relationships between TMY1 and LTMY, LLNO, PL, HL and LLP were high and ranged 0.79 - 0.86. VanRaden *et al*., (2004) reported that genetic correlation between first lactation milk yield and PL was 0.03.

Zahed (2004) found that genetic correlation between first lactation 305-day milk yield (M3051) with longevity traits (LLNO, HL, PL and LLP) were 0.16, 0.12, 0.13 and 0.36, respectively. Genetic relationships between M3051 and LM305 and LTMY were positive (0.67 and 0.57) with LM305 and LTMY, respectively (Zahed, 2004). Jenko *et al*., (2015) found that genetic correlations between M3051 and LTMY was 0.48 indicating that a moderated predictive ability of M3051 for LTMY. Hoque and Hodges (1980) found that genetic relationship between M3051 and LTMY was 0.56 in the Canadian Holstein population. A weak positive genetic relationship between M3051 and PL (0.23) reveals that cows with high potential for first lactation milk yield are also genetically superior for PL (Jenko *et al*., 2015). Genetic correlation between lactation period of first lactation (LP1) with each of LLNO, HL, PL and LLP were -0.34, -0.11, -0.09 and -0.09, respectively, however it was -0.44 and -0.12 between LP1 with LM305, LTMY, respectively (Zahed, 2004).

**Table 4. Genetic Correlation of First lactation traits and each of longevity lifetime production traits**

| First lactation | Longevity traits | | | | Lifetime production traits | | | | |
|---|---|---|---|---|---|---|---|---|---|
| traits[c] | LLNo | HL | PL | LLP | LM305 | LTMY | LMYHL | LMYLP | LLPHL |
| NSC1 | -0.805 | -0.880 | -0.816 | -0.833 | 0.899 | 0.885 | 0.865 | 0.878 | -0.862 |
| CR1 | -0.848 | -0.873 | -0.830 | -0.820 | -0.825 | -0.848 | -0.843 | -0.864 | 0.860 |
| CFS1 | -0.873 | -0.854 | -0.849 | 0.840 | 0.809 | 0.816 | 0.840 | 0.819 | 0.883 |
| SP1 | -0.920 | -0.922 | -0.885 | -0.989 | -0.923 | -0.905 | -0.894 | 0.897 | -0.875 |
| DO1 | -0.925 | -0.918 | -0.908 | -0.981 | -0.984 | -0.901 | -0.837 | 0.845 | -0.823 |
| M3051 | 0.944 | 0.908 | 0.987 | 0.964 | 0.991 | 0.918 | 0.933 | 0.970 | 0.931 |
| TMY1 | 0.917 | 0.939 | 0.924 | 0.978 | 0.959 | 0.909 | 0.974 | 0.904 | 0.900 |
| LP1 | 0.973 | 0.922 | 0.904 | 0.913 | 0.948 | 0.931 | 0.977 | 0.928 | 0.930 |
| DMY1 | 0.963 | 0.923 | 0.912 | 0.978 | 0.932 | 0.961 | 0.941 | 0.954 | 0.915 |

**b: abbreviation as described in table 2.**

**c: NSC1: number of services per conception for cow, CR1: conception rate for cow, CFS1: calving to first service for cow, SP1: service period for cow, DO1: days open for cow, LP1: lactation period for cow, DMY1: daily milk yield for cow, M305: 305-day milk yield for cow, TMY1: total milk yield for cow.**

Phenotypic relationships in the present study were lower than genetic correlations. Phenotypic correlations were negative (Table 5) between NSC1 and LLNO (-0.725) between CR1 and each of HL, PL and LLP (-0.834, -0.806

and -0.914, respectively), between CFS1 and LLNO (-0.732). Phenotypic relationship between SP1 and each of LLNO, HL, PL and LLP were -0.681, -0.824, -0.842 and -0.712, respectively, as well as relationship of DO1 with the same traits were -0.768, -0.867, -0.885 and -0.809, respectively (Table 5).

Phenotypic correlations between first lactation fertility traits and lifetime production traits were negative -0.922, -0.959, -0.866, -0.858 and -0.812 between NSC1 and each of LM305, LTMY, LMYHL, LMYLP and LLPHL, respectively (Table 5). Phenotypic correlations between SP1 and each of LM305, LTMY, LMYHL, LMYLP and LLPHL were 0.714, 0.896, 0.779, 0.789 and 0.820, respectively (Table 5). The relationship between DO1 and the same traits were 0.756, 0.866, 0.781, 0.797 and -0.832 (Table 5). Phenotypic correlation between DO1 with PL was -0.20 (VanRaden *et al*., 2004). Phenotypic correlation between first lactation calving interval (CI1) with longevity traits were -0.13 for LLNO, -0.04 for HL and -0.04 for PL, however it was -0.12 for LM305, -0.10 for LTMY and -0.09 for LLP (Zahed, 2004). Tekerli and Kocak (2009) reported that phenotypic correlation between CI1 with each of HL and PL were -0.01 and -0.01.

Phenotypic correlations were medium to high positive between M3051 and each of LLNO, HL, PL and LLP and ranged from 0.779 to 0.933, as well as relationship between DMY1 and LLNO, HL, PL and LLP which ranged from 0.530 to 0.799 (Table 5). However, relationship between TMY1 and HL, PL and LLP were negative medium (-0.514, -0.585 and -0.669, respectively) as well as the negative medium relationship between LP1 and LLNO, HL, PL and LLP (-0.714, -0.559, -0.577 and -0.659, respectively, table 5). Phenotypic correlations between each of M3051 and DMY1 with lifetime production traits were medium to high and ranged from 0.705 between M3051 and LMYHL to 0.992 between DMY1 and LTMY (Table 5). However, negative medium to high phenotypic correlations were recorded between TMY1 and lifetime production traits and ranged from -0.828 between TMY1 and LM305 to -0.938 between TMY1 and LTMY (Table 5). The same trend was found between LP1 and lifetime production traits and ranged from -0.894 between LP1 and LM305 to -0.932 between LP1 and LMYLP (Table 5).

Sadek *et al*., (2009) reported that phenotypic correlations ranged from 0.10 between TMY1 and LLNO to 0.30 between TMY1 and LTMY. Hoque and Hodges (1980) found that phenotypic correlations between TMY1 and each of LTMY, LLNO, PL and HL ranged from 0.26 to 0.36. Phenotypic correlation between TMY1 and each of PL and LTMY until the third lactation were 0.08 and 0.54, respectively (Valencia *et al*., 2002). Jairath *et al*., (1995) reported that phenotypic correlations between TMY1 and LTMY, LLNO, PL, HL and LLP were small and ranged from 0.46 to 0.57. VanRaden *et al*., (2004) reported that phenotypic correlations between first lactation milk yield with PL was 0.13. Zahed (2004) reported that phenotypic correlation between first lactation 305-day milk yield (M3051) with longevity traits (LLNO, HL, PL and LLP) were 0.14, 0.15, 0.14, ND 0.18, respectively, however it was positive with lifetime production traits (LM305 and LTMY), 0.29 and, respectively. Phenotypic correlations between LP1 with each of LLNO, HL, PL and LLP were -0.12, -0.03, -0.03 and -0.06, respectively, however it was -0.11 and -0.08 between LP1 with LM305 and LTMY, respectively (Zahed, 2004). Tekerli and Kocak (2009) reported that phenotypic correlations between TMY1 and each of HL and Pl were 0.06 and 0.05, and between LP1 with the same two traits were -0.01 and -0.02.

**Table 5. Phenotypic Correlations of First lactation traits and each of Longevity and lifetime production traits**

| First lactation traits[c] | Longevity traits[b] | | | | Lifetime production traits[b] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LLNo | HL | PL | LLP | LM305 | LTMY | LMYHL | LMYLP | LLPHL |
| NSC1 | -0.725 | 0.836 | 0.819 | 0.933 | -0.922 | -0.959 | -0.866 | -0.858 | -0.812 |
| CR1 | 0.708 | -0.834 | -0.807 | -0.914 | 0.929 | 0.955 | 0.819 | 0.865 | 0.880 |
| CFS1 | -0.732 | 0.845 | 0.879 | 0.958 | 0.904 | 0.973 | 0.821 | -0.810 | -0.848 |
| SP1 | -0.681 | -0.824 | -0.842 | -0.712 | 0.714 | 0.896 | 0.779 | 0.789 | 0.820 |
| DO1 | -0.768 | -0.867 | -0.885 | -0.809 | 0.756 | 0.866 | 0.781 | 0.797 | -0.832 |
| M3051 | 0.779 | 0.828 | 0.860 | 0.933 | 0.932 | 0.989 | 0.795 | 0.705 | 0.857 |
| TMY1 | 0.690 | -0.514 | -0.585 | -0.669 | -0.828 | -0.938 | -0.918 | 0.986 | -0.901 |
| LP1 | -0.714 | -0.559 | -0.577 | -0.659 | -0.894 | -0.921 | -0.906 | -0.932 | -0.921 |
| DMY1 | 0.799 | 0.530 | 0.541 | 0.658 | 0.832 | 0.992 | 0.909 | 0.929 | 0.910 |

**b: abbreviation as described in table 2, c: abbreviation as described in table 4.**

## CONCLUSION

Early selection is essential to minimize generation interval and subsequently increase genetic progress. Highly negative genetic correlations between each of heifer fertility traits and first lactation fertility traits with each of longevity and lifetime production traits, suggest that younger age calvers and short days open had long productive life and more lifetime milk yield. Reducing AFC is an effective strategy for dairy farmers to reduce costs. AFC can significantly affect both herd life and productive life, and could be very profitable to the extent that it does not harm reproductive efficiency and minimize heifer rearing costs. Reducing AFC had a highly and multi-dimensional benefits, so, proper modification of rearing programs need to accommodate early calving to reap maximum benefits.

High negative genetic correlation between first lactation fertility traits and both longevity and lifetime traits reveal that cow fertility traits in first lactation plays a major role in longevity and lifetime production traits. Selection on first lactation production traits seems to be most desirable for changing lifetime production traits due to its high positive genetic correlation with total lifetime production.

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# العلاقات بين صفات الأداء المبكر وصفات طول الحياة وطول الحياة الإنتاجية فى ماشية الفريزيان فى مصر

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## الملخص

تهدف هذه الدراسة لتحديد العلاقة بين صفات كل من العجلات والموسم الأول مع صفات كل من طول الحياة وطول الحياة الإنتاجية لعدد 2914 بقرة فريزيان فى الفترة من 1979 وحتى 2013. تم حساب معامل الإرتباط الوراثى والمظهرى بين صفات كل من العجلات والموسم الأول وكذلك صفات كل من طول الحياة وطول الحياة الإنتاجية. كانت قيم معامل الإرتباط الوراثى قوية وسالبة بين كل من LLNO , PL وكلا من AFB, ASB, AFC, بينما كانت قيم معامل الإرتباط قوية وموجبة بين صفة HL وكلا من AFB, ASB, AFC. كانت قيم معاملات الإرتباط الوراثى قوية وسالبة بين صفة NSC0 وكل من LLNO, HL, PL، بينما كانت قيم معامل الأرتباط قوية وموجبة بين كل من CR0, SP0 وكلا من LLNO, HL, PL. كانت قيم معامل الإرتباط الوراثى موجبة بين صفات العمرفى العجلات وكل صفات طول الحياة الإنتاجية. تم حساب معامل الإرتباط الوراثى والمظهرى بين صفات الموسم الأول وصفات طول الحياة وكانت قوية وسالبة، بينما كانت معاملات الإرتباط بين الصفات الإنتاجية للموسم الأول وطول الحياة قوية وموجبة. كانت قيم معامل الإرتباط الوراثى بين صفات الخصوبة للموسم الأول وصفات طول الحياة الإنتاجية متوسط إلى مرتفعة. كانت قيم معامل الإرتباط الوراثى بين الصفات الإنتاجية للموسم الأول وصفات طول الحياة الإنتاجية قوية وموجبة.