# FACTORS AFFECTING REPRODUCTIVE TRAITS IN SEVERAL BREEDS OF DAIRY CATTLE IN IRAQ

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**ABSTRACT**

**This study aimed to investigate the factors affecting reproductive traits using records collected during two calving seasons (2016-2017) and (2017-2018) from three herds of dairy cattle bred at Erbil-Iraq, and includes 323 lactation period (LP), 159 age at first calving (AFC) and 159 calving interval (CI). GLM within SAS used to diagnose the significance effects of the available factors affecting the studied traits. Repeatability of LP also estimated. Overall mean of LP, AFC and CI for the three breeds in all herds were 300.14 days, 27.709 months, and 360.26 days respectively. Simmental recorded significantly ($p<0.01$) higher LP (302.95 days) comparing with Friesian (296.81 days) and Bokane (293.24 days). Differences in LP due to the herd were significant ($p<0.01$). LP decline significantly ($p<0.01$) from 306.05 days in the 1st parity to 290.22 days in the 4th parity. Effects of year and season of calving on LP were not significant. Cows calved females had significantly longer LP (299.39 days) than cows calved males (295.95 days). Regression of LP on AFC (0.207 day/mo.) was not significant, while regressions on body weight of cow at calving (0.088 day/kg) and on birth weight of their calfs (1.661 day/kg) were significant. Repeatability estimate for LP was 0.55. Differences in AFC due to the breed were highly significant, while the effect of herd, year and season of birth were not significant. Regression of AFC on their body weight at calving was not significant (-0.01 day/kg). Differences among the breeds, herds and parities in their CI were not significant. Cows calved in winter and spring recorded significantly shorter CI as compared with those calved in summer and autumn. Regression coefficient of CI on AFC (0.692 day/mo.) was not significant, while the regression on body weight of cow at calving (0.151 day/kg) was highly significant.**

**Key words: Lactation Period, Reproductive Traits, Repeatability.**
*** Part of Ph.D. Dissertation of the 2nd author**



# العوامل المؤثرة في الصفات التناسلية لبعض سلالات أبقار الحليب في العراق

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**المستخلص**

**تهدف الدراسة الى بحث تأثير بعض العوامل في الصفات التناسلية، إذ تم تسجيل وجمع السجلات المستخدمة في هذه الدراسة خلال الموسمين (2016-2017) و (2017-2018) من ثلاث قطعان لأبقار الحليب مرباة في أربيل ، العراق وتضمنت 323، 159 و 159 سجلا لطول فترة الحلب ، العمر عند الولادة الأولى والفترة بين ولادتين على التوالي. استخدم الانموذج الخطي العام ضمن البرنامج SAS لتشخيص التأثيرات المعنوية للعوامل المؤثرة في الصفات قيد الدراسة. تم تقدير المعامل التكراري لصفة طول فترة الحلب. بلغ المتوسط العام لطول فترة الحلب، العمر عند الولادة الأولى والفترة بين ولادتين 300.14 يوم ، 27.709 شهر و 360.26 يوم على التوالي. سجلت أبقار السيمنتال معنويا ($p<0.01$) أطول فترة لأنتاج الحليب (302.95 يوم) مقارنة بالفريزيان (296.81 يوم) والبوكاني (293.24 يوم)، وكانت الاختلافات بسبب القطيع في هذه الصفة معنوية ($p<0.01$). أنخفض طول فترة الحلب معنويا ($p<0.01$) من 306.05 يوم في موسم الحلابة الأول الى 290.22 يوم في الموسم الرابع ، بينما لم يكن تأثير سنة وموسم الولادة معنويا في هذه الصفة. كانت فترة الحلب للأبقار التي ولدت أناثا معنويا أطول (299.39 يوم) من تلك التي ولد ذكور (295.95 يوم). كان انحدار طول فترة الحلب على العمر عند الولادة الأولى (0.207 يوم/ شهر) غير معنويا، بينما كان الانحدار على وزن البقرة عند الولادة (0.088 يوم/كغم) ووزن المولود عند الميلاد (1.661 يوم/كغم) معنويا. بلغ تقدير المعامل التكراري لطول فترة الحلب 0.55. كانت الاختلافات في العمر عند الولادة الأولى عالية المعنوية بسبب السلالة، في حين لم يكن للقطيع، سنة وموسم الميلاد أي تأثير معنوي في هذه الصفة وكذلك لم يكن الانحدار على وزنها عند الولادة (-0.01 يوم/كغم) معنويا. تبين ان الاختلافات في الفترة بين ولادتين بسبب السلالة ، القطيع وموسم الولادة لم تكن معنوية. سجلت الأبقارالوالدة في الشتاء والربيع معنويا أقصر فترة بين الولادتين مقارنة بتلك الوالدة في الصيف والخريف. كان انحدار هذه الصفة على العمر عند الولادة الأولى (0.692 يوم/شهر) غير معنويا، بينما كان الانحدار على وزن جسمها عند الولادة (0.151 يوم/كغم) عالي المعنوية.**

**الكلمات المفتاحية: طول فترة الحلب، الصفات التناسلية، المعامل التكراري.**
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## INTRODUCTION

Lactation period with milk yield assumed to be the two important economic traits of dairy animals which might be dictated by genotype and environmental/non-genetic factors (3). Heinrichs and Vazques-Anon (30) reported that earlier age at first calving would reduce the cost of rearing; increase the income of the herd and shorten the generation interval that lead to an early selection of the bulls and increase the annual genetic improvement. Reproductive performance is one of the major factors influencing the efficiency of milk production; the number of calves produced per cow as well the lifetime milk production, so the higher benefits usually obtained from cows that have higher reproduction ability in the herd for several years (10). Economic traits including lactation period, age at first calving and calving interval are generally controll by genetic factors as well environmental influences such as year, season, and parity that have significant effects (42). Reproductive traits are important in minimizing cost and maximizing the net return from the dairy enterprise, and in determining production efficiency and genetic gain under most dairy production systems (26). However, early studies have demonstrated antagonistic relationships between milk production and reproduction traits. In dairy cattle projects, the breeder (farmer) works to increase the production efficiency of his animals. The objectives of this study were to analyze genetic and non-genetic factors affecting lactation period in Holstein-Friesian, Simmental and Bokanys cattle, as well to investigate the differences in some reproductive traits including age at first calving and calving interval due to genetic and non-genetic effects.

## MATERIALS AND METHODS

Three herds of dairy cattle bred at the stations (Koya, Murtka, and Murtkay Gawra) belong to Erbil-Iraq used in this study. The records collected during two calving seasons (2016-2017) and (2017-2018) and includes 323 lactation period (LP), 159 age at first calving (AFC) and 159 calving interval (CI) of dairy cattle (72 Bokane, 188 Friesian, and 63 Simmental). Hermiz and Hadad (31) described details of management, feeding, health program, mating system, as well a special form arranged to be suitable to record the information for each farm in order to calculate LP, AFC and CI and the factors affecting. General Linear Model-GLM within the statistical programme SAS (49) used to analyze the collected data and to diagnosing the significance effects of the available factors affecting the studied traits. The model for LP includes the effects of breed, herd, parity, year and season of calving, sex of calf, the regressions on age at first calving, body weight of cow at calving, and on birth weight of calf. Model used to analyze AFC contains the effects of breed, herd, year and season of birth, and the regression on body weight of cow at calving. The same model of LP used for analyzing CI with excluding the effect of year of calving, sex of calf and the regression on birth weight of calf. The repeatability of LP was estimated using Restricted Maximum Likelihood (REML) method (41) within SAS (49).

## RESULTS AND DISCUSSION

### Lactation period

Overall mean of LP for the three breeds in all herds was 300.14±0.67 days (Table 1) and within the range reported earlier by several investigators in different breeds of dairy cattle (5, 6, 8, 16, 18; 25, 32, 39, 43). Simmental cows recorded significantly ($p<0.01$) highest lactation period (302.95 days) comparing with that of Friesian (296.81 days) and Bokane (293.24 days) (Table 1). The significant differences may be due to the genotype as well the variations between individuals within a certain dairy breed (51). This trait has a positive and highly significant correlation with milk production, where Abubakar et al. (2) claimed that the genetic correlation was 0.84 in Holstein cows. According to several studies, it appeared that there was a significant effect of breed on lactation period (5, 13, 18, 24, 25, 37). While, the non-significant effect of sire on lactation period reported by Al-Samarai et al. (16) indicated the importance of non-genetic factors in the variation of this trait. The differences in LP due to the herd were significant ($p<0.01$) (Table 1). Also earlier studies noticed the same significant effect of herd on lactation period in different breeds of cows (15, 46). On the hand, Al-Rawi and Al-

Ani (11), Al-Timimy (17) and Coffie (24) didn't revealed to the significant effect of herd on lactation period. Table (1) shows that LP decline significantly ($p<0.01$) from 306.05 days in the 1st parity to 290.22 days in the 4th parity. The significant differences beteen parities in LP also revealed by Al-Rawi et al. (15), Al-Timimy (17), Al-Khazragi (9), Lakshmi et al. (36), Hossein-Zadeh (34), Al-Samarai et al. (16), and Chegini et al. (21). Ram et al. (44) stated that 63.8% of the total variation in lactation period in Tharparkar cows was due to parity and being significant. However, Maarof et al. (38), Aziz et al. (18), Latif (37), Al-Doori (6), Alkass et al. (8), Afzal et al. (3), Abate et al. (1), Badri et al. (19), Yilmaz and Koç (54) and Coffie (24). The differences in LP due to the two year included in this study were not significant (Table 1). Other studies including Al-Rawi and Al-Ani (11), Alkass et al. (8), Abate et al. (1), Badri et al. (19), and Yilmaz and Koç (54) also didn't found any significant effect for this factor on LP. While several researchers found yearly significant difference in LP in different breeds of cows (6, 9, 12, 15, 16, 17, 18, 34, 37, 46) and they claimed that the variation in lactation period due to year of calving could be due to the differences in management, feeding systems and reproductive and veterinary programme. Season of calving didn't affect LP significantly and the differences (Table 1). Some earlier investigators revealed to the same effects regarding to the non-significant effects of season of calving on LP in different breeds that calved during different seasons (1, 5, 8, 18, 19, 20, 24, 36). On the other hand, several researchers reported that there were significant effects of season/month of calving on lactation period in different breeds in several countries (6, 9, 17, 21, 25, 34, 37, 46). It appears from table (1) that cows calved females had significantly ($p<0.05$) longer LP (299.39 days) than cows calved males (295.95 days). Also Chegini et al. (21) found that cows with female calves had longer LP comparing with cows that gave birth to male calves. The effect of calf gender on lactation period assessed to determine whether LP explains the observed difference in milk yield. The birth of a female calf resulted in a lactation between 1.1 and 3.2 days longer than if the calf was male, depending on the breed of the cow and lactation number. While, Hess et al. (33) conversely noticed that cows with female calves had significantly lower LP than those with male calves. On the other hand, Habib et al. (28) and Coffie (24) reported that sex of calf born has little or no influence on LP, which means that LP of cows giving birth to male and females were similar ($p>0.05$). Although the regression coefficient of LP on age at first calving (AFC) was positive (0.207 day/mo.) but it didn't reveal to the significant level (Table 1). The non-significant effect of AFC on LP confirmed by several studies (6, 9, 17, 37). While others noticed that AFC affect LP significantly especially the first lactation of cows (50). In Iraq, Al-Rawi and Said (13) reported a significant correlation (0.10) between age at first calving and the first lactation period in Friesian cattle, and that could be attributed to the relation between the body weight of heifers and their feeding. The effect of body weight of cow at calving on LP studied as regression was positive (0.088 day/kg) and highly significant (table 1). Body condition score (BCS) of cow at breeding season could be consider an indicater for body weight. In this subject, Watters et al. (53), Gergovska et al. (27) and Coffie (24) reported that BCS significantly ($p<0.01$) affected LP. The regression coefficient of cow's LP on birth weight of their calfs was significantly positive and estimated to be 1.661 day/kg ($P<0.01$) (Table 1). Repeatability estimate in this study for LP was 0.55, which mean 55 % of the variation in LP could be improve by improving the environmental condition and will help the breeder in selecting his animals earlier in order to increase the productive effieciency of the flock. The estimated value in this study as greater than those estimated earlier using different breeds of dairy cattle (17, 23).

**Table 1. Least square means±standard errors and mean square for the effects on lactation period (days) of cows**

| Factors | d.f. or No. | Lactation Period (days) |
|---|---|---|
| | | Mean square or Means ± S.E |
| Overall mean | 323 | 300.14 ± 0.67 |
| Breed: | 2 | 1260.32 ** |
| Bokane | 72 | 293.24 ± 1.34 b |
| Friesian | 188 | 296.81 ± 1.51 b |
| Simmental | 63 | 302.95 ± 1.75 a |
| Herd: | 2 | 1706.80 ** |
| Murtkay Gawra | 89 | 287.57 ± 1.85 b |
| Murtka | 194 | 303.73 ± 1.55 a |
| Koya | 40 | 301.70 ± 1.83 a |
| Parity: | 3 | 460.51 ** |
| 1 | 68 | 306.05 ± 2.38 a |
| 2 | 138 | 299.53 ± 1.09 b |
| 3 | 82 | 294.88 ± 1.59 c |
| ≥4 | 35 | 290.22 ± 2.52 c |
| Year of Calving: | 1 | 16.598 |
| 2015-2016 | 164 | 297.33 ± 1.14 a |
| 2016-2017 | 159 | 298.00 ± 1.13 a |
| Season of Calving: | 3 | 78.837 |
| Winter | 137 | 297.94 ± 1.07 a |
| Spring | 73 | 299.11 ± 1.28 a |
| Summer | 48 | 296.39 ± 1.55 a |
| Autumn | 65 | 297.22 ± 1.35 a |
| Sex of Calf: | 1 | 595.73 * |
| Male | 127 | 295.95 ± 1.16 b |
| Female | 196 | 299.39 ± 0.94 a |
| Regression on: | | |
| Age at First Calving | 1 | 22.847 |
| | 323 | 0.207 ± 0.14 |
| Body Weight of Cow | 1 | 1329.92 ** |
| | 323 | 0.088 ± 0.02 |
| Birth Weight of Calf | 1 | 1818.88 ** |
| | 323 | 1.661 ± 0.39 |
| Residual | 307 | 100.2664 |

**Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.**
**** P<0.01**
***** P<0.05**

## Age at first calving

Age at first calving (AFC) for all breeds and herds averaged 27.709 months (Table 2) and lays within the range revelaled earlier by several invesigators (6, 8, 22, 29, 32, 35, 37, 46, 48). The differences in AFC due to the breed were highly significsnt and Friesian breed recorded the shortest AFC (27.301 mo.) than Bokane (28.604 mo.) and Simmental (28.852 mo.) (Table 2). Earlier study conducted by Hammoud et al. (29) confirms that sire had highly significant effect on this trait. Meanwhile, Oudah et al. (40) indicated non-significant effect of sire on AFC. The effect of herd on AFC was not significant (Table 2). Previously, USDA (52) showed that mean AFC in 2002 was inversely related to herd size, where AFC was 25.5 months when herd size was <100 cows and it was 24.6 months when herd size was >500 cows. Rehman et al. (46) conducted a study in Pakistan using Sahiwal cows and revealed to a significant effect of herd on age at first calving. The differences in AFC due to year of birth were not significant (Table 2). In addition, some studies didn't revealed to the significant effect for this factor on age at first calving (38). While other investigators reported that the variation in reproductive traits including age at first calving due to year of birth could be attributed to the differences in management, feeding systems, reproductive and veterinary programme, and environmental conditions which occurred from year to another as well as to differences between years in the quantity and quality of forage available (6, 29, 37, 46). It appears from table (2) that the effect of season of birth on AFC was not significant (p>0.05). This result confirmed by studies conducted previously including Maarof et al. (38), and Hammoud et al. (29). On the other hand, other studies claimed that season/month of birth affect age at first calving significantly (6, 8, 37, 46, 47), which could be attributed to the changes in climatic conditions and feeding regimes during different seasons. The regression coefficient of cow's AFC on their body weight at calving was negative (-0.01 day/kg) and not significant (table 2).

## Calving interval

Overall mean of CI for the three breeds in all herds was 360.26±1.37 days (Table 1) and was shorter than those reported earlier by several investigators in different breeds of dairy cattle (6, 7, 8, 17, 22, 29, 32, 35, 37, 45, 46). It appears from table (2) that the differences between the breeds included in this study in their CI were not significant. Earlierly, Hammoud et al. (29) used 482 Friesian cows with 1921 records and revealed to a highly significant effect of sire on their CI. The differences in CI of cows bred at different herds of this study were not significant (table 2). Earlier study also didn't found any significant effect of herd on this trait (17).

While several researchers claimed that the herd affect CI significantly (46). They noticed that the variation in CI in different herd is significant which could be due to variation in environment, management and feeding system. The effect of parity on CI for cows used in this study was not significant (Table 2). Previous studies (8, 14, 38) also noticed that the effect of parity on calving interval was not significant. Other studies showed that calving interval decreased significantly with increasing age of cow (parity) until the third to fifth parity (6, 7, 17, 29, 37). Cows calved in winter and spring recorded significantly ($p<0.05$) shorter CI comparing with those calved in summer and autumn and being 352.03, 353.64, 358.37 and 361.99 days respectively (Table 2). The significant effect of season or month of calving on CI was also reported in the results of several studies (6, 17, 29, 46). Nevertheless, other researchers found that the differences in calving interval due to season of calving were not significant (4, 8, 14). The regression coefficient of CI on age at first calving (AFC) was positive (0.692 day/mo.) but it didn't reveal to the significant level (Table 2). Earlier studies using different breeds in different countries stated that AFC affect CI significantly (37). On the other hand, other researcher didn't found any significant effect of this age on calving interval (6, 17, 29). The effect of body weight of cow at calving on CI studied as regression and was positive (0.151 day/kg) and highly significant (table 2). This study concluded that exotic breeds of dairy cattle could be improve to be promising dairy animals in Kurdistan Region-Iraq. The results concluded that the studied traits affected by the environmental factors, which mean that the traits can be improve with amelarating the environmental effects.

**Table 2. Least square means ± standard errors and mean square for the effects on age at first calving (mo.) and calving interval (days) of cows.**

| Factors | Age at First Calving (mo.) | | Calving Interval (days) | |
|---|---|---|---|---|
| | d.f. or No. | Mean square or Means ± S.E. | d.f. or No. | Mean square or Means ± S.E. |
| Overall mean | 159 | 27.709 ± 0.11 | 159 | 360.26 ± 1.37 |
| Breed: | 2 | 10.557 ** | 2 | 544.267 |
| Bokane | 36 | 28.604 ± 0.28 a | 36 | 352.07 ± 3.55 a |
| Friesian | 92 | 27.301 ± 0.33 b | 92 | 356.55 ± 4.08 a |
| Simmental | 31 | 28.852 ± 0.36 a | 31 | 360.89 ± 4.40 a |
| Herd: | 2 | 1.150 | 2 | 493.202 |
| Murtkay Gawra | 44 | 27.872 ± 0.45 a | 44 | 352.84 ± 5.47 a |
| Murtka | 95 | 28.498 ± 0.35 a | 95 | 363.63 ± 4.41 a |
| Koya | 20 | 28.117 ± 0.34 a | 20 | 353.04 ± 4.14 a |
| Parity: | | | 3 | 329.310 |
| 1 | | | 67 | 362.50 ± 3.62 a |
| 2 | | | 67 | 358.11 ± 2.70 a |
| 3 | | | 16 | 349.17 ± 5.32 a |
| ≥4 | | | 9 | 356.24 ± 7.96 a |
| Year of Birth: | 3 | 1.569 | | |
| 2011 | 67 | 28.862 ± 0.65 a | | |
| 2012 | 67 | 27.966 ± 0.44 a | | |
| 2013 | 16 | 27.813 ± 0.22 a | | |
| 2014 | 9 | 28.009 ± 0.29 a | | |
| Season of Birth / Calving: | 3 | 0.848 | 3 | 726.049 * |
| Winter | 69 | 28.143 ± 0.23 a | 69 | 352.03 ± 2.84 b |
| Spring | 38 | 28.127 ± 0.27 a | 38 | 353.64 ± 3.31 b |
| Summer | 24 | 28.414 ± 0.32 a | 24 | 358.37 ± 3.95 a |
| Autumn | 28 | 27.965 ± 0.30 a | 28 | 361.99 ± 3.69 a |
| Regression on: | | | | |
| Age at First Calving | | | 1 | 128.125 |
| | | | 159 | 0.692 ± 0.14 |
| Body Weight of Cow | 1 | 0.214 | 1 | 2178.245 ** |
| | 159 | -0.01 ± 0.004 | 159 | 0.151 ± 0.05 |
| Residual | 147 | 1.822 | 146 | 268.325 |

**Means having different letters within each factor/column differ significantly (P<0.05) according to Scheffe's test.**

** P<0.01
* P<0.05

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