*Plant Archives* Vol. 20, Supplement 1, 2020 pp. 9-12 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

# FACTORS AFFECTING PERSISTENCY AND REPEATABILITY IN SEVERAL BREEDS OF DAIRY CATTLE

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## Abstract

Three herds of dairy cattle (Koya, Murtka, and Murtkay Gawra) belong to Erbil Governorate-Iraq used in this study. The records collected during two calving seasons (2016-2017) and (2017-2018) and includes 323 records of persistency of dairy cattle (72 Bokane, 188 Friesian, and 63 Simmental). The persistency measured using two methods (index 1 and 2). General Linear Model-GLM within the statistical programme SAS used to analyze the calculated data and to diagnosing the significance effects of the available factors affecting the persistency. Repeatability of persistency also estimated. The averages of two indices of persistency revealed in this study were 61.091 and 225.06 % for index 1 and 2 respectively. The effect of breed on persistency was significant using index 1 and 2. The differences in persistency according to both indices were highly significant due to the herd and parity effects. Differences in persistency of both indices due to different years and seasons of calving as well sex of calf were not significance. Effect of age at first calving on persistency studied as a regression was not significant and being 0.233 and -0.625 %/mo. in the 1 and 2 index respectively. Regressions of persistency on body weight of cows at calving were highly significant and being 0.089 and 0.208 %/kg depending on index 1 and 2 respectively. Increasing 1 kg in birth weight of calf will improve the persistency of milk production of their dams significantly ($p<0.01$) by 1.068 and 2.246 % using index 1 and 2 respectively. Repeatability being 0.20 and 0.28 using the index 1 and 2 respectively. The present study concluded that persistency of cows could be useful in selecting those have the higher estimates in order to improve the productivity of the herds. Repeatability estimates indicate that persistency is repeatable during the life of the animal.

***Keywords***: Dairy Cattle, Persistency, Repeatability.

## Introduction

Lactation persistency defined as the ability of a cow to maintain production at a higher level after peak yield. Hypothetically, more persistent cows are less susceptible to health and reproductive disorders. Persistency is a trait of economic importance because of its impact on feed costs, health, and fertility (Swalve, 1998 and 2000). Ohashi *et al.* (1990) and Strabel *et al.* (2002) defined the persistency as the ability of cows to maintain their maximum daily yield after the peak of their production for a longest possible period. While Gengler *et al.* (1998) defined the persistency as the flat curve for the daily milk yield throughout the lactation period, which does not descend immediately after the peak. VanRaden (1998) and Koloi *et al.* (2018) claimed that cows with high persistency tend to produce milk more than the expected at the end of lactation period and less than the expected at the beginning. Lin and Togashi (2002a) reported that the appropriate strategy to improve the persistency is to reduce the period of production before the peak and increase the period after the peak. The persistency of lactation is affected by various environmental factors such as genetic group, sire effect, herd management, lactation number, feeding, gestation and season of calving of animals (Koloi *et al.*, 2018). Swalve (1995) summarized three measures of persistency: (1) the ratio of milk yield in the last trimester of lactation to that in the first trimester, (2) the ratio of maximum test day milk yield to mean test day milk yield, and (3) the standard deviation of test day yields. While Lin and Togashi (2002b) used two methods to measure the persistency: (1) The first depend on the ratios of yields during segments of lactation, they divide lactation period into two stages: the first from 5-60 days and the second from 61-305 days, then they partitioned these stages into sub-stages, after that the genetic merit for each stage could be estimated to construct the selection index to improve the persistency in producing milk. (2) The second depend on the standard deviations of partial milk production periods.

The objective of this study was to study the persistency of milk production in different breeds and locations using different methods and estimate the persistency of cows depending on the ability values of their milk production in order to select those have the higher estimates.

## Materials and Methods

Three herds of dairy cattle (Koya, Murtka, and Murtkay Gawra) belong to Erbil Governorate-Iraq used in this study. The records collected during two calving seasons (2016-2017) and (2017-2018) and includes 323 records of persistency of dairy cattle (72 Bokane, 188 Friesian, and 63 Simmental). Hermiz and Hadad (2019) 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 the persistency and the factors affecting.

Persistency: There were several methods to measure the persistency (Madsen, 1975), the following two methods were used in this study:

a. Persistency Index = (milk produced during 3$^{rd}$ 100 days/ milk produced during 1$^{st}$ 100 days)*100.

b. Persistency Index = (milk produced during 305 days/ daily peak milk produced).

General Linear Model-GLM within the statistical programme SAS (2005) used to analyze the collected data and to diagnosing the significance effects of the available factors affecting the persistency. The model 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. The repeatability of persistency was estimated using Restricted Maximum Likelihood (REML) method (Patterson and Thompson, 1971) within SAS (2005).

## Results and Discussion

The averages of two indices of persistency revealed in this study were 61.091 ± 0.64 and 225.06 ± 1.29 % for index 1 and 2 respectively (Table 1). The mentioned values indicate that the cows included in this study have good persistency in their milk yield and this result confirmed earlier by VanRaden (1998) and Koloi *et al.* (2018) who claimed that cows with high persistency tend to produce milk more than the expected at the end of lactation period and less than the expected at the beginning. Lin and Togashi (2002a) reported that the appropriate strategy to improve the persistency is to reduce the period of production before the peak and increase the period after the peak.

**Table 1 :** Least square means ± standard errors for the effects on persistency index (%) of cows.

| Factors | No | Means ± S.E. | |
|---|---|---|---|
| | | Persistency Index 1 (%) | Persistency Index 2 (%) |
| Overall mean | 323 | 61.091 ± 0.64 | 225.06 ± 1.29 |
| Breed: | | | |
| Bokane | 72 | 66.107 ± 1.38 a | 230.30 ± 2.92 a |
| Friesian | 188 | 55.942 ± 1.55 b | 218.26 ± 3.28 b |
| Simmental | 63 | 66.532 ± 1.81 a | 233.26 ± 3.83 a |
| Herd: | | | |
| Murtkay Gawra | 89 | 57.935 ± 1.90 b | 211.59 ± 4.02 c |
| Murtka | 194 | 63.283 ± 1.59 ab | 228.07 ± 3.36 b |
| Koya | 40 | 67.364 ± 1.88 a | 242.16 ± 3.98 a |
| Parity: | | | |
| 1 | 68 | 70.149 ± 2.45 a | 242.96 ± 5.18 a |
| 2 | 138 | 65.504 ± 1.12 b | 232.54 ± 2.37 b |
| 3 | 82 | 59.936 ± 1.64 c | 221.58 ± 3.47 c |
| 4 < and more | 35 | 55.853 ± 2.60 c | 212.03 ± 5.49 c |
| Year of Calving: | | | |
| 2016-2017 | 164 | 64.475 ± 1.18 a | 228.54 ± 2.49 a |
| 2017-2018 | 159 | 61.246 ± 1.17 a | 226.01 ± 2.47 a |
| Season of Calving: | | | |
| Winter | 137 | 63.371 ± 1.11 ab | 229.18 ± 2.35 a |
| Spring | 73 | 64.714 ± 1.33 a | 230.56 ± 2.80 a |
| Summer | 48 | 60.154 ± 1.59 b | 222.89 ± 3.37 a |
| Autumn | 65 | 63.203 ± 1.40 ab | 226.47 ± 2.95 a |
| Sex of Calf: | | | |
| Male | 127 | 63.453 ± 1.19 a | 227.35 ± 2.52 a |
| Female | 196 | 62.268 ± 0.97 a | 227.20 ± 2.05 a |
| Regression on: | | | |
| Age at First Calving | 323 | 0.233 ± 0.44 | -0.625 ± 0.42 |
| Body Weight of Cow | 323 | 0.089 ± 0.02 | 0.208 ± 0.05 |
| Birth Weight of Calf | 323 | 1.068 ± 0.40 | 2.246 ± 0.48 |

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

**Table 2 :** Mean squares and test of significance for factors affecting persistency index of cows.

| Factors | d.f. | Mean squares | |
|---|---|---|---|
| | | Persistency Index 1 | Persistency Index 2 |
| Breed | 2 | 1218.93 ** | 1874.62 * |
| Herd | 2 | 505.31 ** | 5376.90 ** |
| Parity | 3 | 422.51 ** | 1866.90 ** |
| Year of Calving | 1 | 381.04 | 233.23 |
| Season of Calving | 3 | 192.60 | 642.94 |
| Sex of Calf | 1 | 70.688 | 1.073 |
| Regression on : | | | |
| Age at First Calving | 1 | 29.02 | 209.02 |
| Body Weight of Cow | 1 | 1396.34 ** | 7635.18 ** |
| Birth Weight of Calf | 1 | 751.18 ** | 3323.89 ** |
| Residual | 307 | 106.38 | 475.008 |

** P<0.01 * P<0.05

It appears from table (2) that the effect of breed on persistency was significant using index 1 (P<0.01) and index 2 (P<0.05), where the persistency of dairy cattle belongs to Bokane and Simmental Breeds was higher comparing with that of Friesian using both indices (Table 1). Previously, several studies estimated the persistency with a range of 71.4-77.6% in crossed Czech Pied x Holstein Friesian x Ayrshire cows (Ponizil, 1989), and were 74.2 % in crossed Kenana x Friesian cows (Abate *et al.*, 2010), 75.16 % in Butana dairy cows (Badri *et al.*, 2011), 11.00 in Phule Triveni synthetic cow (Garudkar *et al.*, 2018). While, Koloi *et al.* (2018) and Sharma *et al.* (2018) observed that genetic group of animals did not show significant effect on persistency indices of milk production.

The higher and lower persistency were registered in Koya and Murtkay Gawra herds respectively by using both indices (Table 1) and the differences between the three herds used in this study were highly significant (Table 2). This result could be due to climatic conditions, management and the size of the herd.

The differences in persistency according to both indices were highly significant (Table 2) due to the parity, where the persistency decline from 70.149 and 242.96 % in the first parity to 55.853 and 212.03% in the fourth parity of the 1 and 2 indices respectively (Table 1). This decline could be explained by the decrease in total milk production and lactation period with the progress of parity found in this study (Hermiz and Haddad, 2019). Also Koloi *et al.* (2018) claimed that the reason of cows at first parity were more persistent may be due to presence of more number of secretary cells in mammary gland, which maintain their secretary activity for a longer duration. Earlier study conducted by Gill *et al.* (1970) claimed that parity contributed 2.25% of the total variance in persistency and the effect was significant and confirmed by other studies using different breeds (Singh *et al.*, 2000; Kumar and Singh, 2006; Yilmaz and Koç, 2013; Otwinowska-Mindur and Ptak, 2015; Zurwan *et al.*, 2017 and Koloi *et al.*, 2018). While other studies (Al-Rawi *et al.*, 1980; Al-Zubaidi, 2000; Badri *et al.*, 2011 and Garudkar *et al.*, 2018) reported that the effect of parity on persistency of different breeds was not significant.

Differences in persistency of both indices for the two years included in this study did not reveal to the level of significance (Tables 1 and 2). The above result confirmed by several studies using different breeds conducted by Al-Rawi and Al-Ani (1981), Ribas and Perez (1990), Al-Zubaidi (2000), Badri *et al.* (2011) and Yilmaz and Koç (2013). Whereas, other authors revealed to significant differences in persistency of producing milk in dairy cattle calved in different years (Al-Rawi *et al.*, 1980; Ohashi *et al.*, 1990; Singh *et al.*, 2000; Kumar and Singh, 2006; Garudkar *et al.*, 2018; Koloi *et al.*, 2018 and Sharma *et al.*, 2018).

Although there were no significant effect of calving season on persistency using both indices (Table 2), it appears that cows calved in spring had higher persistency using the first index comparing with those calved in other seasons (Table 1). The non-significant effect of season of calving on persistency measured in several breeds of dairy cattle represented by Ribas and Perez (1990), Al-Zubaidi (2000), Patond (2009), Badri *et al.* (2011) and Garudkar *et al.* (2018). While, other studies conducted around the world noticed a significant effect of season of calving on persistency (Prasad *et al.*, 1999; Kumar and Singh, 2006; Guler and Yanar, 2009; Yilmaz and Koç, 2013 and Koloi *et al.*, 2018).

Tables 1 and 2 shows that the differences between cow with male calf or female calf were not significant in their persistency in producing milk according to both indices. Also Atashi *et al.* (2012) noticed the same result. On the contrary, Colburn *et al.* (1997) and Chegini *et al.* (2015) found that cows with female calf had higher persistency of milk than those with male calf.

The effect of age at first calving on persistency studied as a regression was not significant and being 0.233 and -0.625 %/mo. in the 1 and 2 index respectively (Tables 1 and 2). Similar results were reported earlier by Kumar and Singh (2006), Patond (2009) and Garudkar *et al.* (2018) using different breeds.

The regressions of persistency on body weight of cows at calving were highly significant and being 0.089 and 0.208% /kg depending on index 1 and 2 respectively (Tables 1 and 2). This result indicated that improving the body weight of cows will increase the persistency.

It appears that increasing 1 kg in birth weight of calf will improve the persistency of milk production of their dams by 1.068 and 2.246 % using index 1 and 2 respectively, and the regression effects were highly significant (Tables 1 and 2).

The repeatability for milk persistency being 0.20 and 0.28 using the index 1 and 2 respectively. These estimates were similar or greater than that registered earlier in several breeds when the persistency calculated using different methods (Rao and Sundareson, 1982; Ishag, 2000; Badri *et al.*, 2011; and Kumar and Singh, 2006).

## Conclusions

The present study concluded that: (1) the estimate of persistency of cows depending on the ability values of their milk production could be useful in selecting those have the higher estimates in order to improve the productivity of the herds. (2) repeatability estimates indicate that persistency is repeatable during the life of the animal, which mean that the traits could be improve by selecting the best animals.

## References

Abate, A.L.; Atta, M. and Anthony, R.N. (2010). Seasonal variation of milk persistency of Kenana x Friesian crossbred dairy cows under confinement feeding in a hot environment. Anim. Sci. Journal, 1 (1): 13-18.

AL-Rawi, A.A. and AL-Ani, L.M. (1981). Evaluation of imported Vs native born Friesian bulls in Iraq. Indian J. Anim. Sci., 51(4): 395-397.

Al-Rawi, A.A.; Said, S.I. and Al-Cassey, A.A. (1980). Some factors affecting the shape of lactation curve. Iraqi J. Agric. Sci., 15: 17-25.

Al-Zubaidi, A.M. (2000) Evaluation of bulls performance and its effect on some genetic and production parameters in Friesian cattle. Ph.D. Thesis, College of Agriculture and Forestry, University of Mosul. (Arabic).

Atashi, H.; Zamiri, M.J. and Sayyadnejad, M.B. (2012). Effect of twinning and stillbirth on the shape of lactation curve in Holstein dairy cows of Iran. Arch Tierz 55(3): 226-233.

Badri, T.M.; Atta, M.; Ibrabim, M.T. and Gubartalla, K.A. (2011). Genetic and non-genetic factors affecting production potential of Butana dairy cows at Atbara Research Station, Sudan. Research Opinions in Animal & Vethrinary Sciences. roavs, 1(7): 429-433.

Chegini, A.; Hossein-Zadeh, N.G. and Hosseini-Moghadam, H. (2015). Effect of calf sex on some productive, reproductive and health traits in Holstein cows. Spanish Journal of Agricultural Research, 13(2): 7.

Colburn, D.J.; Deutscher, G.H.; Nielsen, M.K. and Adams, D.C. (1997). Effects of sire, dam traits, calf traits, and environment on dystocia and subsequent reproduction of two-year-old heifers. J Anim Sci 75: 1452-1460.

Garudkar, S.R.; Pachpute, S.T. and Deokar, D.K. (2018). Studies on Persistency of Milk Yield and Its Association with Production Traits in Phule Triveni Synthetic Cow Department of Animal Science and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri, India. Int. J. Curr. Microbiol. App. Sci., 6: 1585-1589.

Gengler, N.; Keown, Jeffrey. F.; Van, Vleck Lloy, D.D. (1998). Various persistency measures and relation shops with total, partial and peak yields. Genetics and Breeding, P.O. Box 166, clay center, Ne68933, Fax: 4021762-4173.

Gill, G.S. (1970). Inheritance of persistency and peak yield in Hariana cattle and their relationship with lactation yield. M.Sc. thesis, Punjab Agricultural University, Hissar, India.

Guler, O. and Yanar, M. (2009) Factors Influencing the Shape of Lactation Curve and Persistency of Holstein Friesian Cows in High Altitude of Eastern Turkey. Journal of Applied Animal Research, 35(1): 39-44.

Hermiz, H.N. and Hadad, J.M. (2019). Factors affecting and estimates of repeatability for milk production and composition traits in several breeds of dairy cattle. Under publication data.

Ishag, LA. (2000). Impact of Genetic and non-genetic factors on productive and reproductive traits of crossbred cows raised under Sudan condition. M. V. Sc. thesis, University of Khartoum – Sudan (Cited by Badri *et al.*, 2011).

Koloi, S.; Pathak, K.; Behera, R.; Mandal, D.K.; Karunakaran, M.; Dutta, T.K. and Mandal, A. (2018). Factors affecting the persistency of milk production in Jersey crossbred cattle. J Dairy Vet Anim Res. 2018; 7(6): 268-271.

Kumar, A. and Singh, A. (2006). Genetic and Environmental factors influencing persistency of milk production in Karan Fries cattle. Indian J. Anim. Res. 40(2): 95-100.

Lin, C.Y. and Togashi, K. (2002a). Optimal Strategy to modify the shape of the lactation curves. 7th World Congress on Genetics Applied to Livestock production, Montpiller, France.

Lin, C.Y. and Togashi, K. (2002b). Simultanous improvement of Lactation milk and persistency. 7th World Congress on Genetics Applied to Livestock Production, Montpiller, France.

Madsen, O. (1975). A comparison of some suggested measures of persistency of milk yield in dairy cows. Animal production 20: 191-197.

Ohashi, T.; Katayama, H.; Yamauoni, K.; Haga, S. and Naka Mura, N. (1990). Effect of calving season on milk production of dairy cattle. Japanese Journal of Dairy and food science. 36(5): A. 191-A. 195. Animal Breed. Abstr. 58.6: 3408.

Otwinowska-Mindur A. and Ptak, E. (2015). Genetic analysis of persistency in the Polish Holstein-Friesian cows. Animal Science Papers and Reports. 33: 109–117.

Patond, M.N. (2009). Persistency of milk yield in Jersey cattle. M.Sc. (Agri).Thesis, M.P.K.V., Rahuri (India).

Patterson, H.D. and Thompson, R. (1971). Recovery of intertblock information when block size unequal. Biometrika. 58: 545-554.

Ponizil, A. (1989). Milk yield of three breed crossbreds of Friesian, Ayrshire and Czech Pied cattle. Animal Breeding Abstract, 31(4): 12-16.

Prasad, S.; Singh, R. and Bisht, G.S. (1999). Measure of persistency and its relationship with peak yield and lactation milk yield. Indian Journal of Dairy Science, 52: 308-314.

Rao, M.K. and Sundareson, D. (1982). Factors affecting shape of lactation curve in Friesian x Sahiwal. crossbred cows. Indian Journal of Dairy Science, 35(2): 160-167.

Ribas, M. and Perez, B. (1990). Monthly test day milk records and yields at 244 days. 1 – Environmental effects in first lactation. Ani. breed. Abstract, 58(2): 513.

SAS. (2005). SAS/STAT' User's Guide for Personal Computers. Release 8.2. SAS Institute Inc., Cary, NC, USA.

Sharma, N.; Narang, R. and Ratwan, P. (2018). Genetic analysis of persistency in HF crossbred cattle at an organized farm of northern India. Tropical Animal Health and Production. 50(6): 1219-1225.

Singh, K.; Khanna, A.S. and Kanaujia, A.S. (2000). Factors affecting lactation performance and persistency in crossbred cattle. Indian J. Dairy Sci. 53(5): 354-360.

Strabel, T.; Witold, K. and Tomasz szwaczkowski. (2002). Genetic Evaluation of persistency in Random Regression Test Day Model. Department of Genetics and Animal Breeding. August Ciezkowski Agricultural University Ul. Wolynska 33: 60 – 637.

Swalve, H.H. (1995). The effect of test day models on the estimation of genetic parameters and breeding values for dairy yield traits. J. Dairy Sci., 78: 929-938.

Swalve, H.H. (1998). Use of test day records for genetic evaluation. Proc. 6th World Congr. Genet. Livest. Prod. Armidale, January 11-16. New South Wales, Australia. 23: 295-302.

Swalve, H.H. (2000). Theoretical basis and computational methods for different test-day evaluation method. J. Dairy Sci., 83: 1115-1124.

VanRaden, P.M. (1998). Best prediction of lactation yield and persistency Tektran, United States Department of Agriculture, Agricultural Research Services.

Yilmaz, H. and Koç, A. (2013). A Research on Milk Yield, Persistency, Milk Constituents and Somatic Cell Count of Red Holstein Cows Raised Under Mediterranean Climatic Conditions. Bulgarian Journal of Agricultural Science, 19(6): 1401-1407.

Zurwan, A.; Moaeen-ud-Din M. and Bilal, G. (2017). Estimation of genetic parameters for persistency of lactation in Sahiwal dairy cattle. Pakistan Journal of Zoology, 49(3):877-882.