

Genetic and Non-genetic Factors Influencing First Lactation 305 Days or Less Milk Yield (FL305MY) Trait of Karan Fries Cattle

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(Received 16 August 2021, Accepted 15 October, 2021)

(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT : The actual performance records of first lactation 305 days or less milk yield (FL305MY) trait of Karan Fries cattle is a result of the interaction of both acting various genetic and non-genetic factors and thus, poor indicator their breeding values. The first lactation 305-day or less milk yield (FL305MY) records of 1481 Karan-Fries cows sired by 83 bulls calved during the period of 26 years from 1984 to 2009 remained after data editing were utilised in present study from the history-cum pedigree sheet and daily milk yield registers maintained at National Dairy Research Institute (NDRI), Karnal. The least squares mixed model fitting effect of genetic (sire) and non-genetic factors (periods, season and age groups) were used to analyze the data of FL305MY. The effect of sire (P 0.01) and age at first calving groups (P 0.05) was found to have significant effect on FL305MY. The season of calving and period of calving had non-significant effect on FL305MY. No definite trend of increase or decrease in FL305MY was observed across the seasons and periods. The FL305MY registered an increasing trend across the age groups. The heritability of FL305MY was estimated to be 0.346 ± 0.101 . The effect of sire and age at first calving on FL305MY in KF should be adjusted with the effects of genetic and non-genetic factors for enhancing the accuracy of genetic parameters. The heritability estimate of FL305MY was moderate in magnitude which indicated that it is more influenced by additive genetic variability. Hence, there is more scope of improvement by selection and breeding. The information on genetic and non-genetic factors and genetic parameters can be utilized for formulation of proper breeding and management strategies in order to improve milk yield traits in Karan Fries cattle.

Keywords: Genetic, non-genetic, factors, first lactation 305 days or less milk yield, Karan Fries, cattle.

INTRODUCTION

Crossbred cattle with 50.42 million (26.18%) population contribute 22.48% milk to total country milk production (All India 20th Livestock Census, 2019). Crossbred cattle have the potentiality to meet the ever increasing demand of both quality and quantity of milk from increasing population of health conscious and enhanced paying capacity of consumers. The milk production from crossbred cattle is further important due to shrinkage of land due to urbanisation. The Karan Fries is one of the most promising cross-breed of cattle developed from crossing of Tharparkar females with Holstein Friesian males through systemic breeding at National Dairy Research Institute (NDRI), Karnal (Gurnani *et al.*, 1986). Crossbred cattle have been observed to be more susceptible to managerial factors, health and reproductive problems. The first lactation 305-day or less milk yield (FL305MY) trait is the most important economic trait of the dairy animal productivity which

determines profitability from animal farming. Thus it serves as most important selection criteria of animal improvement worldwide, culling/retaining criteria of cows and improves the economic efficiency of dairying. Further, it is also considered as the most important trait for assessing the genetic progress of the herd because of its reduced generation interval attributes. The wide variation in FL305MY trait of Karan Fries cattle has been observed which is attributed to the marked influence of acting various genetic and non-genetic factors. Thus, actual performance records of FL305MY trait of Karan Fries cattle is poor indicator of their breeding values. The information on the effect of genetic and non-genetic factors on milk production traits in Karan Fries cattle is scanty (Sinha 1999; Saha 2001; Singh and Gurnani, 2004; Rashia, 2010). The genetic improvement of a trait with selective breeding require genetic variation existing in the target population as raw material. The genetic variability for a particular trait in a target population is indicated by heritability estimate under given environmental

conditions. The accuracy of heritability estimation enhanced with accounting the effect of Genetic and non-genetic factors. Thus, the estimates of genetic and non-genetic parameters are helpful in determining the method of selection to predict direct and correlated response to selection, choosing a breeding system to be adopted for future improvement as well as in the estimation of genetic gains. Accordingly, the present investigation was undertaken to assess the different genetic and non-genetic factors and relative influence on first lactation 305-day milk yield (FL305MY) trait which are useful for designing the breeding programmes to bring about genetic improvement in milk yield of Karan Fries cattle.

MATERIALS AND METHODS

The first lactation 305-day or less milk yield (FL305MY) records of 1481 Karan-Fries cows sired by 83 bulls calved during the period of 26 years from 1984 to 2009 were collected for present study from the history-cum pedigree sheet and daily milk yield registers maintained at National Dairy Research Institute (NDRI), Karnal. The Karan Fries cows those had produced milk for less than 100 days and culled in the middle of lactation, abortion, still-birth or any other pathological causes which affected the lactation yield were not taken for the study. The outliers beyond two-standard deviation on both the tail ends of normal distribution were excluded from the data. The records of progenies of only those sires were included in present study which had minimum five or more progenies in data records. The cows that had produced milk for at least 100 days and maximum 305 days in the first lactation were considered for the study. A total of 15% records were discarded on account of these restrictions. The cows were maintained under uniform condition of feeding, housing, breeding milking, health cover and other managemental condition. The data were classified into different seasons, periods and age groups to determine the effect of non - genetic factors on performance trait of first lactation i.e. first lactation 305-day or less milk yield (FL305MY). The year was divided into four seasons (Winter: December to March; Summer: April to June; Rainy: July to September; Autumn: October & November.) The periods were classified into 5 periods considering year to year differences. Five age groups were formed using Sturges formula (Daniel, 2006). The effect of genetic (sire) and non-genetic factors (periods, season and age group) were analyzed using the following mixed model for first lactation 305-day or less milk yield (FL305MY) trait.

$$Y_{ijklm} = \mu + P_i + S_j + M_K + A_l + e_{ijklm}$$

Where, Y_{ijklm} is observation on the M^{th} progeny in l^{th} age group k^{th} season j^{th} sire and i^{th} period

μ is overall mean

P_i is fixed effect of i^{th} period

S_j is random effect of j^{th} sire which is NID $(0, \sigma_s^2)$

M_K is fixed effect of k^{th} season

A_l is fixed effect of l^{th} age group

e_{ijklm} is the random error associated with each record which is NID $(0, \sigma_e^2)$

Duncan's multiple range test as modified by Kramer (1957) was used for testing differences among least square means. Paternal half sib correlation method (Becker, 1975) under least-squares mixed model (LSML) using Harvey, (1990) was used to estimate the heritability of performance trait. The standard error of heritability of different traits was estimated using the formula given by Swiger *et al.* (1964).

RESULTS AND DISCUSSION

Effect of genetic and non-genetic factors on FL305MY. The overall least-squares means of FL305MY was 3199 ± 31 Kg (Table 1). The estimate obtained in the present study was in close agreement with those reported by Sivakumar (1998); Sinha (1999); Singh and Gurnani (2004); Kokate (2009); Rashia (2010); Nehra (2011) and Divya (2012) in Karan Fries cattle at NDRI Farm, Karnal. However, slightly lower least-squares means of FL305MY was reported by Sahana and Gurnani (2000); Saha (2001) in Karan Fries cattle.

Sire: Least-squares ANOVA revealed highly significant effect (P 0.01) of sire on FL305MY (Table 1). Significant effect of sire on FL305MY was also reported by Singh (1995); Nehra (2011); Divya (2012) in Karan Fries cattle.

Season: The effect of season of calving on FL305MY was non-significant (Table 1). The first lactation 305 days or less milk yield (Table 3) was observed to be highest (3262 kg) in summer calvers followed by rainy (3190 kg), autumn (3178 Kg) and winter (3167 Kg) calvers. Singh (1995); Sivakumar (1998); Singh (2006); Rashia (2010); Nehra (2011); Divya (2012); Tripathy *et al.* (2017) in Karan Fries (KF) cattle at NDRI observed non-significant effect of season on FL305MY. However, Sinha (1999); Sahana and Gurnani (2000); Saha (2001); Singh and Gurnani (2004) and Kokate (2009) in Karan Fries (KF) cattle reported significant effect of season on FL305MY.

Period: The period of calving did not had significant influence on FL305MY (Table 1). However, among the period groups the highest FL305MY was recorded (3244 Kg) during 2004–2009 and lowest (3163Kg) during 1989–1993. No definite trend of increase or decrease in FL305MY was observed across the periods. Non-significant effect of period of calving was also reported by Sinha (1999); Singh and Gurnani (2004); Nehra (2011) and Divya (2012) in KF cattle at NDRI herd. However, Singh (1995); Sivakumar (1998); Sahana and Gurnani (2000); Saha (2001); Singh (2006); Kokate (2009); Tripathy *et al.* (2017) in Karan Fries cattle reported significant effect of period of calving on 305-day milk yield.

Table 1: Least-squares means of first lactation 305 days or less milk yield (FL305MY) trait.

Factors	Grp	FL305MY (Kg)
Overall (μ)		3199 \pm 31
Period (1984-1988)	1	3201 \pm 118
Period (1989-1993)	2	3163 \pm 105
Period (1994-1998)	3	3194 \pm 103
Period (1999-2003)	4	3193 \pm 96
Period (2004-2009)	5	3244 \pm 132
Season (Winter)	1	3167 \pm 37
Season (Summer)	2	3262 \pm 43
Season (Rainy)	3	3190 \pm 52
Season (Autumn)	4	3178 \pm 68
Age (723-836 Days)	1	3022 ^a \pm 64
Age (837-950 Days)	2	3183 ^b \pm 43 (392)
Age (951-1064 Days)	3	3235 ^c \pm 40
Age (1065-1178 Days)	4	3249 ^d \pm 56
Age (1179 Days)	5	3305 ^e \pm 79

Age at first calving groups: The effect of age at first calving groups on FL305MY was found to be significant (P 0.05). Among the age groups, the highest FL305MY was recorded 3305 Kg during the calving age of 1179 days and lowest 3022 Kg during the calving age of 723-836 days. The FL305MY registered an increasing trend across the age groups. Significant effect of age at first calving groups was also reported by Nehra, (2011) in KF at NDRI farm. However, Singh (1995); Divya (2012) in Karan Fries cattle reported non-significant effect of age at first calving groups on milk production.

Genetic parameter: The heritability of FL305MY from mixed model using LSML was estimated to be 0.346 \pm 0.101 (Table 1). The heritability estimate of FL305MY was close to the estimates 0.30 \pm 0.02 reported by Saha (2001) and 0.39 \pm 0.09 by Kokate (2009) in Karan Fries cattle. Higher heritability estimates of FL305MY in Karan Fries cattle have been reported as 0.44 \pm 0.13 by Sivakumar (1998); 0.41 \pm 0.13 by Sahana and Gurnani (2000); 0.45 \pm 0.18 by Singh (2006); 0.48 \pm 0.01 by Nehra (2011) and 0.49 \pm 0.09 by Tripathy *et al.* (2017). Lower heritability estimates of FL305MY have been reported as 0.20 \pm 0.06 by Rashia (2010) and 0.21 \pm 0.14 by Divya (2012) in Karan Fries cattle. The heritability estimate of FL305MY was moderate in magnitude which indicated that it is more influenced by additive genetic variability and have wide genetic variability. Hence, the heritability of FL305MY in KF cattle presents ample scope of its genetic improvements with selective breeding.

The effect of sire and age at first calving on FL305MY in KF should be adjusted with the effects of genetic and non-genetic factors for enhancing the accuracy of genetic parameters. Effective breeding programs depend on the accuracy of genetic and phenotypic parameter estimates. The moderate heritability estimate of FL305MY reflects the importance of including the trait for genetic improvement with selective breeding.

Hence, the information on genetic and non-genetic factors and genetic parameters can be utilized for formulation of proper breeding and management strategies in order to improve milk yield traits in Karan Fries cattle.

Acknowledgements. We sincerely thank the Director, National Dairy Research Institute, Karnal and Head, Dairy Cattle Breeding Division for providing necessary facilities for conducting this research. Further, I greatly acknowledge the efforts extended by author Aakanksha Rathore for preparation of this manuscript.

REFERENCES

- Becker, W. A. (1975). *Manual of Quantitative Genetics*. 3rd Edition. Pub. Program in Genetics, Washington State University, Washington, USA.
- Divya, P. (2012). *Single versus multi-trait models for genetic evaluation of fertility traits in karan fries cattle*. M.V.Sc. Thesis. NDRI (Deemed University), Karnal, India.
- Daniel, W. W. (2006). *Biostatistics: A foundation for analysis in the health sciences*. Wiley publication, 7th Edition. Pp.18.
- Gurnani, M. Sethi, R. K., & Nagacenk, R. (1986). Development of Karan Fries cattle at NDRI, Karnal. Dairy Information Bulletin No. II, vol. 9: 1-2.
- Harvey, W. R. (1990). *Guide for LSMLMW, PC-Iversion, mixed model least squares and maximum likelihood computer programme, January 1990*. Mimeograph Ohio State, university, USA.
- Kokate, (2009). *Genetic evaluation of Karan Fries sires based on Test day milk records*. (Deemed University) Karnal, India.
- Nehra, M. (2011). *Genetic analysis of performance trends in Karan Fries cattle*. M.V.Sc. Thesis. NDRI (Deemed University), Karnal, India.
- Rashia, (2010). *Genetic evaluation of the lactation curve in Karan Fries cattle*. Ph. D. Thesis, NDRI (Deemed University) Karnal, India.
- Saha, S. (2001). *Generation wise genetic evaluation of Karan Swiss and Karan Fries cattle*. M.Sc. Thesis. NDRI, Deemed University, Karnal, India.

- Sahana, G., & Gurnani, M. (2000). Performance of crossbred cattle and comparison of sire evaluation methods under organized farm condition. *Indian J. Anim. Sci.*, 70(4): 409-414.
- Singh, M. K. (1995). *Factors affecting trend in performance of Karan Swiss and Karan Fries cattle*. Ph.D Thesis, NDRI (Deemed University) Karnal, India.
- Singh, M. K., & Gurnani, M. (2004). Performance evaluation of Karan Fries and Karan Swiss cattle under closed breeding system. *Asian Australian J. Anim. Sci.*, 17(1): 1-6.
- Singh, S. (2006). *Genetic evaluation of Karan Fries sires on the basis of part lactation milk yield*. M. V. Sc. Thesis submitted to NDRI (Deemed University) Karnal, India.
- Sinha, S. (1999). *Studies on level of heterozygosity of Karan Fries animals*. M.Sc. Thesis, NDRI (Deemed University), Karnal.
- Sinha, S. (1999). *Studies on level of heterozygosity of Karan Fries animals*. M.Sc. Thesis, NDRI (Deemed University), Karnal.
- Sivakumar, R. (1998). *Reproductive performance at different levels of production in Karan Fries cattle*. M.Sc. Thesis, National Dairy Research Institute, Karnal, Haryana.
- Swiger, L. A., Harvey, W. R., Everson, D. O., & Gregory, K. E. (1964). The variance of intraclass correlation involving groups with one observation. *Biometrics*. 20: 818-826.
- Tripathy, S. S., Atish Kumar Chakravarty, Mohsin Ayoub Mir., Arun Pratap Singh, Valsalan Jamuna & Sreela Lathika (2017). Genetic and Non-Genetic Parameters of First Lactation Milk Yield, Composition and Energy Traits in Karan-Fries Cattle. *Journal of Animal Research*, 7(1): 49-57.

How to cite this article: Rathore, A.; Singh, R.K. and Singh, A. (2021). Genetic and Non-genetic Factors Influencing First Lactation 305 Days or Less Milk Yield (FL305MY) Trait of Karan Fries Cattle. *Biological Forum – An International Journal*, 13(4): 398-401.