SUSTAINABILITY OF MILK PRODUCTION IN SURTI BUFFALO ON AN ORGANIZED FARM

Pandya Gaurav Mulvantray[1,*], Joshi Chaitanya[2], Rank Dharamshi[2], Kharadi Vishnu[1], Vataliya Pravin[3], Desai Prakash[4] and Solanki Jitendra[2]

ABSTRACT

Lactation curve and persistency of the lactation are the important parameters to study the sustainability of the lactation. The present study is based on daily milk production records for 298 lactations (maximum four lactations per animal) from 130 buffaloes belonging to 15 sires. Statistical Packages for Social Sciences (SPSS) programme was used to prepare the lactation curve. Two most widely applied functions to study the lactation curve in Indian buffaloes i.e. gamma and inverse polynomial functions, were fitted to the daily milk yield records of the animals under study. Persistency was studied by carrying out simple analysis through Microsoft Excel 2000 on the weekly milk yield records of the animals. Gamma function was found to be more effective with higher R^2 value for all the four lactations to prepare the lactation curve as compared to inverse polynomial function. The value of persistency was found to be ranging from 97.94% to 98.56% for the fourth lactation to the first lactation, respectively. So it was concluded that gamma function can be effectively used to establish lactation curve and predict milk yield of animals on any day of lactation and Surti buffaloes as fairly persistent in milk production throughout the lactations.

Keywords: *Bubalus bubalis*, buffaloes, lactation curve, persistency, Surti buffalo

INTRODUCTION

Buffaloes are considered as principle milk producing livestock species in India. India has got almost 56% of the total buffalo population of the world with 105.3 million buffalo heads (Livestock census 2007). Out of that, Gujarat has got 8.77 million buffalo population inclusive of Jafarabadi, Mehsani, Surti and Banni animals. The home tract of Surti buffalo breed is Central and Southern part of Gujarat state. The breed is generally found in various districts of Middle and South Gujarat.

To study the sustainability of production, lactation curve and persistency are important parameters. The studies on lactation curve have found their own importance in understanding the production performance of animal and nature of the

[1]Department of Animal Genetics and Breeding, College of Veterinary Science and Animal Husbandry, Navsari Agricultural University, Gujarat, India, *E-mail: gmp2004@gmail.com
[2]College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, India
[3]College of Veterinary Science and Animal Husbandry, Junagadh Agricultural University, Junagadh, India
[4]College of Veterinary Science and Animal Husbandry, Navsari Agricultural University, Navsari, India

lactation. Different models have been used to study the lactation curve in Indian buffaloes, of which, gamma type and inverse polynomial models have been found most suitable for such studies.

Persistency of lactation is another parameter apart from lactation curve to know the characteristics of the lactation. Persistency of lactation has also been studied extensively and it is also one of the important tools to know the production sustainability of the lactation.

Most of the published research work pertaining to studies on lactation characteristics and important production traits is available on Murrah and Nili Ravi breeds. However, the information on Surti buffaloes is lacking and need to be studied for formulating an effective selection programme. As limited information is available on performance of Surti animals on organized farm, present study was planned with the objective to study lactation characteristics of Surti buffaloes through lactation curve and persistency of lactation parameters.

MATERIAL AND METHODS

The data for the present study were collected from the breeding and production records of all the farm born progenies between the period of 1988 to 2002 maintained at Livestock Research Station, erstwhile Gujarat Agricultural University, Navsari. Data on daily milk yield (morning and evening) were collected up to four lactations from 130 buffaloes. Such daily milk records for 298 lactations were collected. These 130 buffaloes were progenies of 15 sires.

Four sets of data for first, second, third and fourth lactation records were organized and two different lactation curve functions were fitted to the organized average daily records. The Statistical Packages for Social Sciences (SPSS version 10.1) programme was used to find out constants for various mathematic functions to establish lactation curve. Non-linear regression in the SPSS programme function was used to find out the constants. The following two mathematical lactation curve functions were studied.

(i) Gamma function (Wood, 1967)

$$Y_t = a.\ t^b.\ e^{-ct}$$

(ii) Inverse Polynomial function (Nelder, 1966)

$$Y_t = t\ (a + bt + ct^2)^{-1}$$

Where Y_t is defined as milk yield at time 't', 'a' is the initial yield after calving, 'b' is the linear regression constant measuring the average slope of the lactation curve and 'c' describes the rate of change during the decline phase.

The parameters 'a', 'b' and 'c' were estimated for each of the lactation. The goodness of fit of function was compared by using the values of co-efficient of determination. (R^2).

For the analysis of persistency, average weekly yield data for first, second, third and fourth lactation records were organized in Microsoft Excel 2000. The persistency value was calculated by utilizing the method Pradhan and Dave (1973). The formula used to determine persistency (%) was as follows.

$$\frac{\left\{\frac{8th\ wk\ yield}{7th\ wk\ yield}\ x\ 100\right\} + \left\{\frac{9th\ wk\ yield}{8th\ wk\ yield}\ x\ 100\right\} + \cdots\ldots\ldots + \left\{\frac{42nd\ wk\ yield}{41st\ wk\ yield}\ x\ 100\right\}}{n-1}$$

Where n = Total no. of weeks

RESULTS AND DISCUSSION

Lactation curve functions

Two different mathematical functions were used to establish lactation curve for first, second, third and fourth parity in Surti buffaloes.

The information regarding value of different constants for Surti buffaloes in four parities is presented in Table 1. The Corresponding coefficient determination (R^2) value for both the functions are also presented in the Table 1.

The values of R^2 in the Table 1 show that in all four lactations, gamma function fits better in the Surti buffalo as compare to inverse polynomial. The present findings are also matching with the findings of Kumar and Bhat (1979); Yadav *et al.* (1995), where they stated that gamma type function was found to be most suitable for deciding lactation curve in Indian buffaloes. Suhail *et al.* (1998) have fitted inverse polynomial function in Nili-Ravi buffaloes where they have reported that inverse polynomial did not explain the ascending phase efficiently.

Further, Bhat and Kumar (1980) have reported R^2 value as 99 for gamma type function in Murrah buffaloes. Similarly Vij *et al.* (1985) have also reported R^2 value as 0.97 to 0.99 for gamma function in Indian buffaloes as compare to that of inverse polynomial 0.78 to 0.95. However, Dimauro *et al.* (2005) have also studied various mathematical models to study the lactation curve in Italian Water buffaloes, in which, they have reported Wood function R^2 as much as 0.937. M. Muñoz *et al.* (2008) studied five different models to study lactation curve in the Murrah buffalo and their corssbred under extensive system, in which they reported Quadratic logarithmic function as the best fit followed by inverse polynomial. M. A. Aziz *et al.* (2006) have also compared incomplete gamma function in Egyptian buffaloes with a new model. They suggested that incomplete gamma model under estimated the peak yield. Sahoo *et al.* (2018) suggested polynomial regression function as the best fit model to describe the lactation curve on the basis of weekly milk yield data in Murrah buffaloes.

These all the findings indicate that Gamma type may be one of the very good models to study lactation curve in Water buffaloes.

Persistency of lactation

Overall persistency for weekly milk production up to four lactations in Surti buffaloes are given in Table 2. The persistency was measured up to 42 weeks of the lactation.

Dave and Taylor (1975) have reported 87.29 and 75.62% persistency index for Indian Water buffaloes at two different farms. Khan and Johar (1985) have reported persistency of milk yield in first lactation 87% and that of second lactation 85%. Dhaka and Chaudhry (1994) have also reported 84.22±1.36% persistency for Murrah buffalo. Das *et al.* (2007) have studied and reported the persistency of first lactation of Swamp buffaloes of Assam as 96.99 % and average persistency of five lactations as 97.40%. M. Mohamed (2010) has also studied persistency in Egyptian buffaloes, where he reported that buffaloes in first parity were least persistent and most persistent in fourth parity.

In the present study, the persistency has been found ranging from 97.94 to 98.56%. So as compare to other findings, the present findings reveal very high persistency index for Surti buffaloes for first four lactations.

Table 1. The value of parameter 'a', 'b' and 'c' fitted in different lactations for gamma and inverse polynomial function with their respective R^2 values.

Parity no.	Function	a	b	c	R^2
I	Gamma	1.0330	0.4260	0.0050	0.9178
	Inverse polynomial	2.7130	0.1380	0.0008	0.7489
II	Gamma	1.7270	0.3160	0.0050	0.9678
	Inverse polynomial	1.9300	0.1180	0.0009	0.8560
III	Gamma	1.8500	0.3170	0.0055	0.9549
	Inverse polynomial	1.7540	0.1090	0.0009	0.8340
IV	Gamma	1.7270	0.3490	0.0060	0.9400
	Inverse polynomial	2.0400	0.0090	0.0009	0.8197

Table 2. Persistency for weekly milk production up to four lactations in Surti buffaloes.

Lactation	1	2	3	4
Persistency (%)	98.56	98.00	98.22	97.94

CONCLUSION

Finally from the present findings, it can be concluded that, the gamma function was found more suitable to establish lactation curve in Surti buffalo and Surti buffaloes have higher persistency of lactation. The different functions and factors can be analyzed to study the lactation curve. Still some more intense and dedicated studies are required to come to a conclusion on a wider scale.

REFERENCES

Aziz, M.A., N.A. Shalaby, O.M. El-Shafie, A.T. Mahdy and A. Nishida. 2006. Comparison between the shapes of lactation curve of Egyptian buffalo milk yield estimated by the incomplete gamma function and a new model. *Livestock Research for Rural Development*, **18**(5).

Berrocal, M.M., H. Tonhati, R.A. Borquis and N.H. Lugo. 2008. Uso de modelos lineales y no lineales para el estudio de la curva de lactancia en búfalos Murrah y sus cruces en sistemas de cría extensiva en el estado de São Paulo, **20**(9). Available on: https://repositorio.unesp.br/bitstream/handle/11449/70563/2-s2.0-51149093306.pdf?sequence=1&isAllowed=y

Bhat, P.N. and R. Kumar. 1980. Comparative efficiency of various mathematical functions on adjusted lactation curve in Indian buffaloes. *Indian J. Dairy Sci*., **33**(3):

408-409.

Dimauro, C., G. Catillo, N. Bacciu and N.P.P. Macciotta. 2005. Fit of different linear models to the lactation curve of Italian water buffalo. *Ital. J. Anim. Sci*., **4**(2): 22-24. DOI: 10.4081/ijas.2005.2s.22

Das, A, D. Das, R.N. Goswami and D. Bhuyan. 2007. Persistency of Milk Yield and its correlation with certain economic traits in Swamp buffaloes of Assam. *Buffalo Bull*., **26**(2): 36-39. Available on: http://ibic.lib.ku.ac.th/e-Bulletin/IBBU200700009.pdf

Dave, B.K. and C.M. Taylor. 1975. A study on relationship of persistency with other first production traits in Indian water buffaloes. *Indian Journal of Animal Health*, **14**(1): 77-80.

Dhaka, S.S. and S.R. Chaudhry. 1994. Non-genetic factors influencing persistency of lactation in Murrah buffaloes. *Indian J. Anim. Res*., **28**(2): 117-121.

Elmaghraby, M.M.A. 2010. Lactation persistency and prediction of total milk yield from monthly yields in Egyptian buffaloes. *Lucrari Stiintifice. Seria Zootehnie*, **53**(15). Available on: http://www.univagro-iasi.ro/ revista_zoo/ro/documente/ Pdf_vol2/ Z045_M_Elmaghraby.pdf.

Khan, F.H. and K.S. Johar. 1985. Persistency of first and second lactations in Murrah buffaloes. *Indian J. Anim. Sci*., **55**(3): 201-203.

Kumar, R. and P.N. Bhat. 1979. Lactation curve in Indian buffaloes. *Indian J. Dairy Sci*., **32**(2): 156-160.

Nelder, J. A. 1966. Inverse polynomials, a useful group of multifactor response functions. *Biometrics*, 22: 128

Pradhan, V.D. and A.D. Dave. 1973. A study on the lactation curve and the rate of decline in milk yield in Kankrej cattle. *Indian J. Anim. Sci*., **43**: 914-917.

Sahoo, S.K., A. Singh, S.K. Dash and G.S. Ambhore. 2018. Modeling lactation curve for genetic evaluation of Murrah buffaloes. *Indian J. Anim. Res*., **52**: 1675-1679. DOI: 10.18805/ijar.B-3432

Suhail, S.M., M. Syed and M. Amjad. 1998. Lactation curves and persistency of lactation in *Nili-Ravi* buffaloes. *Sarhad Journal of Agriculture*, **14**(5): 407-410.

Vij, P.K., M.S. Tiwana and M.S. Bhullar. 1985. Factors affecting shape of lactation curve in buffaloes. *Asian Journal of Dairy Research*, **4**(2): 111-115.

Wood, P.D.P. 1967. Algebraic model of the lactation curve in cattle. *Nature*, **216**(5111): 164-165. DOI: 10.1038/216164a0

Yadav, B.S., F.H. Khan and M.C. Yadav, 1995. Lactation curve in Murrah buffaloes. *Indian J. Dairy Sci.*, **48**(9): 570-571.