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Short communication

Factors affecting individual lactation curve shape in Italian river buffaloes

N.P.P. Macciotta [a,*], C. Dimauro [a], G. Catillo [b], A. Coletta [c], A. Cappio-Borlino [a]

[a] *Dipartimento di Scienze Zootecniche, Università di Sassari, Via De Nicola 9, 07100 Sassari, Italia*
[b] *Istituto Sperimentale per la Zootecnica, Monterotondo (Roma), Italia*
[c] *Associazione Nazionale Allevatori della Specie Bufalina (ANASB), Via Cesare Battisti 68, 81100 Caserta, Italia*

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Abstract

Lactation curves for milk yield of 3860 Italian river buffaloes were modelled with the Wilmink function. For this species, a wide range of goodness of fit indicates much variation of shapes among animals. Moreover, about 30% of individual curves showed the atypical shape, i.e., characterised by the absence of the lactation peak. The presence of atypical curves may seriously bias results of analysis based on comparison between individual parameter values. Factors affecting the occurrence of atypical curves were investigated by a logistic regression model. Biological and environmental factors (age at calving and calving season, herd) and, mainly, the structure of data analysed (distance of the first recorded test from parturition) were significantly related to the probability of having an atypical shape.

Keywords: Lactation curve; River Buffalo; Atypical lactation curve shape

1. Introduction

Among the different approaches used to model lactation curves for milk yield, the use of analytical functions of time is able to partition the variability of daily milk yield into a regular and continuous component and into a stochastic one (Beever et al., 1991; Grossman and Koops, 1998; Sherchand et al., 1995). Most of lactation curve studies deal with average patterns of homogeneous groups of animals, even if individual curves are of interest for many practical purposes, e.g., health monitoring, individual feeding and genetic evaluations. Individual curve fitting in dairy cows results in a wide range of goodness of fit, due to the great random variation of shape among animals (Macciotta et al., 2005; Olori et al., 1999; Perochon et al., 1996). Moreover, the occurrence of atypical shapes, characterised by the absence of the lactation peak, occurs in about 20–30%

* Corresponding author. Tel.: +39 79 229298; fax: +39 79 229302.
E-mail address: macciott@uniss.it (N.P.P. Macciotta).

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of cases (Congleton and Everett, 1980; Macciotta et al., 2005; Olori et al., 1999; Rekik and Ben Gara, 2004).

In the current study, factors affecting lactation curve shape of Italian river buffaloes (*Bubalus bubalis*) and the possible occurrence of atypical shapes are studied using the empirical function proposed by Wilmink (1987).

2. Materials and methods

Data were 28,066 test day (TD) records of milk yield belonging to 3860 lactations of Italian river buffaloes recorded by the Italian Association of Animal Breeders in the period 1992–2001. Edits were on the number of tests per lactation (>4) and on the lactation length (<340 days). Lactation curve shape was analysed by fitting individual curves to the Wilmink model (Wilmink, 1987):

$$Y_t = a + b\mathrm{e}^{-kt} + ct \quad (1)$$

where: Y_t = test day milk yield at time t (days) from calving; a, b, c and k = function parameters.

Model (1) was fitted in the linear three parameter form by setting k to 0.19, estimated by fitting model (1) to the whole data set with a non linear regression method.

Estimated curves were ranked according to five levels of adjusted R^2 (ADJRSQ) (1 < 0.30, 2 = from 0.30 to 0.50, 3 = from 0.50 to 0.70, 4 = from 0.70 to 0.90, 5 ≥ 0.90) and were classified as standard or atypical on the basis of the different combination of signs for parameters b and c (Table 2).

Individual parameter values were analysed with the following linear model that included fixed factors supposed to affect average lactation curve shape of buffaloes according to Catillo et al. (2002) and Tekerli et al. (2001):

$$Z_{ijk} = \mathrm{HYS}_i + \mathrm{AGE}_j + e_{ijk} \quad (2)$$

where: $Z = k$-th individual value of parameter a, b or c of Eq. (1); HYS = fixed effect of the i-th herd-year-season combination (120 levels); AGE = fixed effect of the j-th age at calving (1 = age ≤ 3 years, 2 = 3 < age ≤ 4 years, 3 = 4 < age ≤ 5 years, 4 = 5 < age ≤ 6 years, 5 = 6 < age ≤ 7 years, 6 = age > 7 years); e = random residual.

Four calving seasons (1 = January to March, 2 = April to June, 3 = July to September, 4 = October to December) and 10 years of calving (10 levels, from 1992 to 2001) were considered. In order to assess a possible effect of the occurrence of atypical shapes, analysis was carried out both on the whole data set and on curves showing the standard shape.

Finally, factors that may affect the probability of occurrence of atypical curves were analysed by the following logistic regression model (Rekik and Ben Gara, 2004):

$$\log\left(\frac{p}{1-p}\right) = b_0 + \sum_j b_i X_i \quad (3)$$

Table 1
Relative frequencies of fits among different classes of adjusted r^2

ADJRSQ class	Frequency (%)	Cumulated frequency (%)
<0.30	8.81	8.81
0.30–0.50	5.16	13.96
0.50–0.70	9.92	23.89
0.70–0.90	34.61	58.50
>0.90	41.50	100

Table 2
Relative frequencies of the curve shapes that can be theoretically fitted by Wilmink function (the parameter a is always greater than 0)

Parameter		Curve shape	Frequency (%)
b	c		
–	–	Standard curve	66.42
+	–	Continuously decreasing (atypical) curve	30.91
+	+	Reversed standard	0.34
–	+	Continuously increasing	2.33

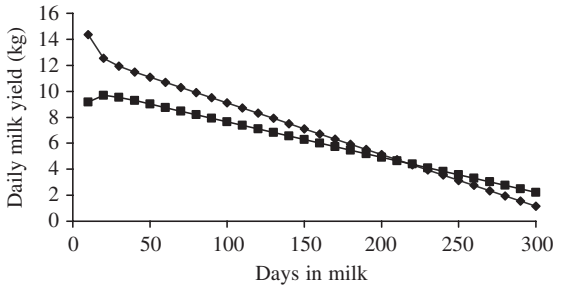

Fig. 1. Examples of standard (■) and atypical individual lactation curves (◆).