

# Effect of Inbreeding Depression on Somatic Cells Counts in the Portuguese Holstein Population

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## Introduction

The relationship between Somatic Cell Counts (SCC) and udder health is well documented in the literature (Green et al., 2004; Haas et al., 2004; Deluyker et al., 2005). It has been postulated that selection against cows with high SCC may be helpful in enhancing resistance to mastitis, as evidenced by the positive genetic correlation found between measures of mastitis incidence and SCC (Lund et al., 1999; Shook and Schutz, 1994). On the other hand, the intense selection for production of milk and milk components over the years has dramatically increased the levels of inbreeding in the dairy cattle population with negative consequences in many traits with economic importance. The effect of inbreeding on udder health is not conclusive, with some authors (Miglior et al., 1995; Sørensen et al., 2006) reporting an increase in SCC with inbreeding and others (Smith et al., 1998; Thompson et al., 2000; Gulisija et al., 2007) failing to identify a significant effect of inbreeding on SCC.

The objective of the present study was to assess the effect of inbreeding on SCC in the Portuguese Holstein cattle.

## Material and Methods

**Data.** Test day (TD) records of SCC recorded from January 2005 to December 2009 and produced by cows born after 1999 were used in this study. The records were provided by ANABLE, the National DHIA. The original data consisted of 3,054,851 observations from the first 3 lactations and were edited to ensure that only herds with at least 3 observations per contemporary group were selected. SCC were normalized using the log transformation ( $SCS = \log(\frac{SCC}{100}) + 3$ ). Further edits followed ICAR (1995) rules for TD recording. Briefly, age at calving had to be between 18 and 45 months, 28 and 58 months and 38 and 78 months for first, second and third lactations, respectively. TD records corresponded to the range of 5 to 305 DIM. After editing, 962,665 records belonging to 201 herds, produced by 74,795 cows, sired by 5,155 bulls, remained for the analysis.

**Model.** An auto regressive Test-Day animal model was used to analyze this data. The Model was similar to the one used in the routine national genetic evaluations (Carvalheira et al., 2002), except for the inclusions of the regressive effect on inbreeding coefficient (linear and quadratic). The model was as follows:

$$y_{ijkLmn} = \text{HTD}_i + \text{Age}_{(H)j} + \text{DIM}_{(H)k(L)} + b_1 F_m + b_2 F_m^2 + a_m + p_{m(L)} + t_{n(mL)} + e_{ijkLmn},$$

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where  $y_{ijkilm}$  is the observation of SCS,  $\mathbf{HTD}_i$  is the fixed effect due to cows tested in the same herd and TD,  $\mathbf{Age}_{(H)j}$  is the fixed effect of age at calving within herd,  $\mathbf{DIM}_{(H)k(L)}$  is the fixed effect for days-in-milk within herd and lactation (30 DIM classes),  $\mathbf{b}_1\mathbf{F}_m$  is the regression on the inbreeding coefficient (IC) for animal  $\mathbf{m}$ ,  $\mathbf{b}_1\mathbf{F}_m^2$  is the regression on the squared IC for animal  $\mathbf{m}$ ,  $\mathbf{a}_m$  is random effect of animal,  $\mathbf{p}_{m(L)}$  is the random effect of long-term environmental effects accounting for the correlations generated by the cow across lactations,  $\mathbf{t}_{n(mL)}$  is the random effect of short-term environmental effects accounting for the correlations due to the cow between TD within each lactation, and  $\mathbf{e}_{ijkilm}$  is the random residual effect. The effects of  $\mathbf{p}$  and  $\mathbf{t}$  are fitted with first-order autocorrelation structures. Variance components and correlations were obtained using derivative free REML methodology (Smith and Graser, 1986).

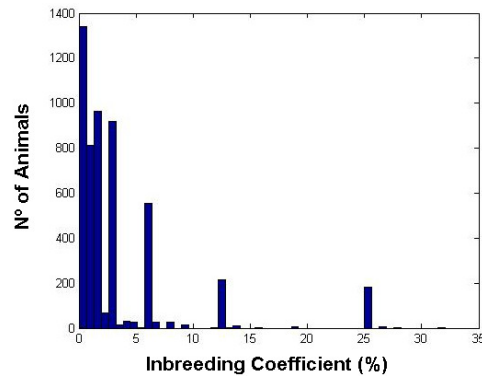
## Results and Discussion

Table 1 gives the mean and SE of the IC for animals born after 1999. IC in this study are below the level reported for other populations (Swalve et al., 2003). However, when considering only inbred animals, the average IC increases dramatically to levels where may have a depressing effect on performance, especially in functional traits.

**Table 1. Number of animals born after 1999, Mean and SE of the Inbreeding Coefficient (%)**

	Number (%)	Mean	SE
All Animals	75493	0.15	0.016
Inbred Animals	3513 (4.65)	3.20	0.085
Sires	698	0.12	0.030
Inbred Sires	35 (5.01)	2.45	0.459
Cows	74795	0.14	0.005
Inbred Cows	3478 (4.65)	3.19	0.086

The IC distribution shows that the majority of the inbred animals are below 5% (Figure 1).



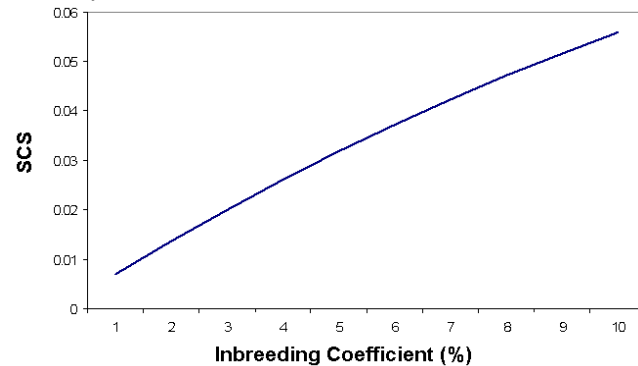
**Figure 1. Histogram of Inbreeding Coefficients in the Portuguese Holstein population.**

On the other hand, the linear regression coefficient for frequency of inbred animals by year of birth was not different from zero (Figure 2). However, the average IC per year of birth, showed a different picture, with a positive trend of 0.01% increase per year (Figure 2).



**Figure 2. Time trends of average Inbreeding Coefficient (IC) in the inbred population (---) and frequency of inbred animals (\_\_\_) by year of birth.**

Both, linear (0.713) and quadratic (-1.546) regressions on the IC significantly ( $P < 0.05$ ) affected SCS unfavorably. The negative quadratic regression indicates that the effect of inbreeding is lower at higher levels of inbreeding. Similar conclusions were reported by Sørensen et al. (2006) for Danish dairy cattle. Figure 3 gives a graphic view of this relationship. This results show that a cow with 5% IC will have more 1,265.2 cells/cm<sup>3</sup> than another cow with only 2% IC.



**Figure 3. Predicted relationship between inbreeding coefficient and somatic cell scores (SCS).**

## Conclusions

The results of this study indicate that inbreeding does have a negative influence on the number of milk somatic cells. Because of the known relationships between SCC and incidence of mastitis, a major cost on the dairy operation, inbreeding should be avoided.

Mating programs that may help farmers organize and choose sires for their cows, should be widely implemented.

### **References:**

- Carvalho et al., (2002). *J. Dairy Sci.* 85:2040-2045.  
Deluyker et al. (2005). *J. Dairy Sci.* 88:604-614.  
Green et al. (2004). *J. Dairy Sci.* 87:1256-1264.  
Gulisija et. Al. (2007). *J. Dairy Sci.* 90:493–500.  
Haas et al. (2004). *J. Dairy Sci.* 87:95-105.  
ICAR (1995). *Int. Comm. For Anim. Rec.*, Rome, Italy  
Lund et al. (1999). *J. Dairy Sci.* 82:1045–1051.  
Miglior et al. (1995). *J. Dairy Sci.* 78:1168-1173.  
Shook and Schutz. (1994). *J. Dairy Sci.* 77:648–658.  
Smith and Graser. (1986). *J. Dairy Sci.* 69:1156-1165.  
Smith et al. (1998). *J. Dairy Sci.* 81:2729-2737.  
Sørensen et al. (2006). *J. Dairy Sci.* 89:4077-4082.  
Swalve et al. (2003). *Proc. EAEP-54th Annual Meeting*, Rome, Italy, 17.  
Thompson et al. (2000). *J. Dairy Sci.* 83:1856-1864.