Inbreeding impact on milk production in Spanish Holstein cows

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INTRODUCTION

Most studies have used the classical inbreeding coefficient (Wright, 1931) to quantify inbreeding effect on milk production, either as a continuous or classified factor. Furthermore, inbreeding depression had not been estimated on milk and related traits in the Spanish Holstein population.

OBJECTIVES

To compare Wright's inbreeding coefficient with an alternative inbreeding measure, and to analyze whether inbreeding depression occurred on production traits (milk, fat and protein, in kg) in a Spanish Holstein population.

MATERIAL AND METHODS

Genetic analyses were performed using VCE 6.0 with 472,640 test-day records from 48,783 first-lactation cows with calving from September 1993 to July 2008. Inbreeding was obtained using ENDOG 4.6 software from a pedigree involving 79,766 animals (Figure 1). Inbreeding was included in the animal model by two approaches:

- Classical measure of inbreeding (F) as a systematic effect
- Individual inbreeding rate (ΔF) as a linear covariate

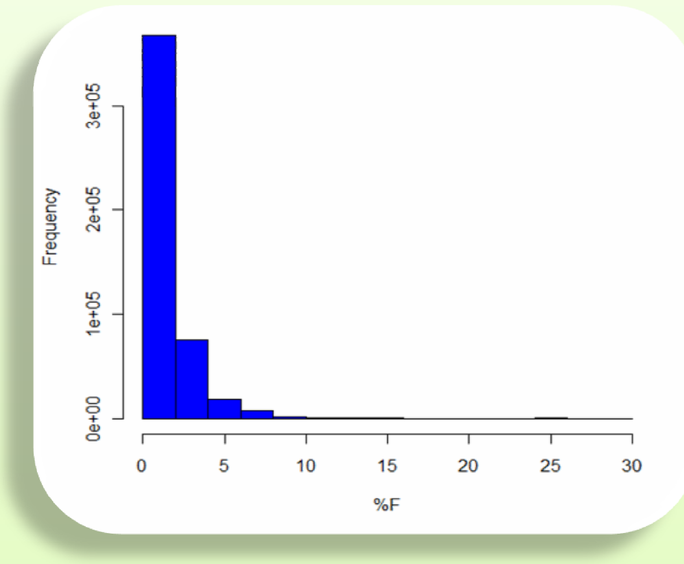

Figure 1. Frequency distribution of inbreeding coefficient (F) for the studied population.

Inbreeding estimation for F < 3.125% was arbitrarily set to the phenotypic mean as reference value, while the remaining levels were computed as the difference on the solution with respect to the reference level. Regarding individual inbreeding rate, the reference value was ΔF=0. Inbreeding depression was extended to 305-day lactation. Model comparison was addressed computing BIC for each model and using BIC difference with respect to reference model as criterion.

RESULTS

Maximum inbreeding on the studied population was 30% and the average inbreeding was 1.65%. Models including ΔF fitted better than models with F (Table 1).

	Milk	Fat	Prot
BIC_F - BIC_W	13.59	26.79	-3.90
$BIC_{\Delta F}$ - BIC_W	-2.66	-7.96	-9.92

Table 1. BIC difference for model considering inbreeding coefficient (BIC_F) and individual inbreeding rate ($BIC_{\Delta F}$) with respect to the model without inbreeding (BIC_W).

A 12.5% inbred first-lactation cow produced 128 kg, 6 kg, and 5 kg less milk, fat, and protein per 305d-lactation, respectively, than a non-inbred cow. Results for F=25% were not conclusive and they could be explained because only 95 records shown that inbreeding level.

Estimated regression coefficients for individual inbreeding rate for milk, fat, and protein were -0.14, -1.63, and -0.16, respectively. Inbreeding depression in a lactation basis is shown in Figure 2 and Figure 3.

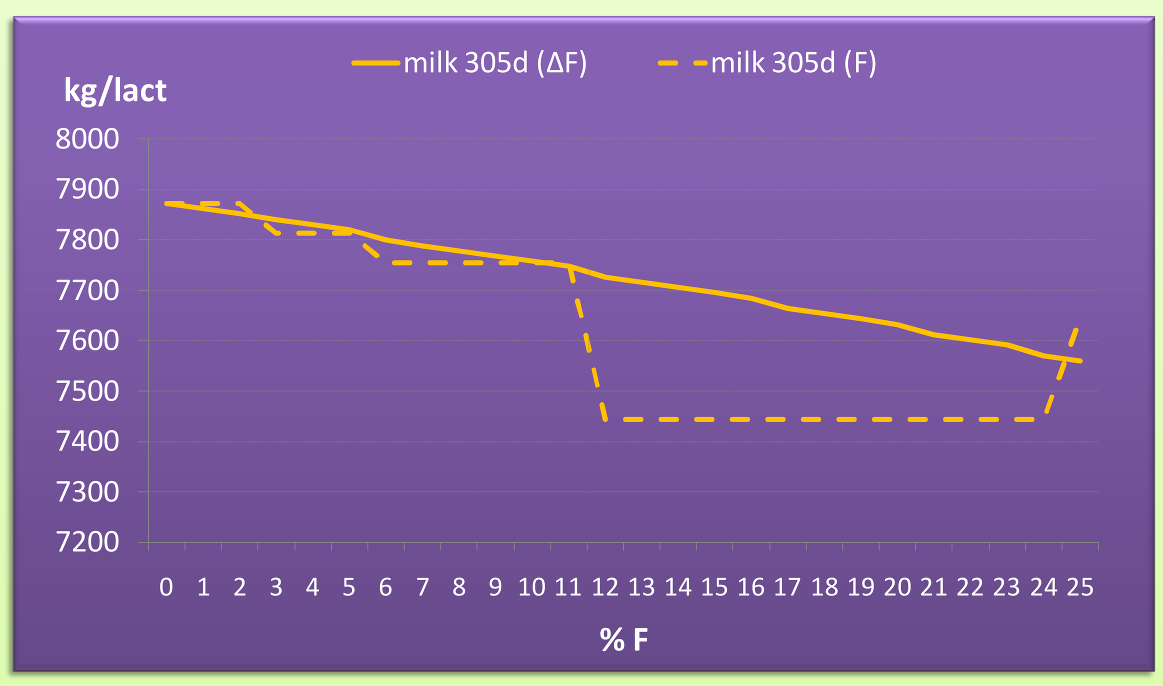

Figure 2. Inbreeding depression for milk yield (in kg per lactation) considering inbreeding coefficient (F) and individual inbreeding rate (ΔF).

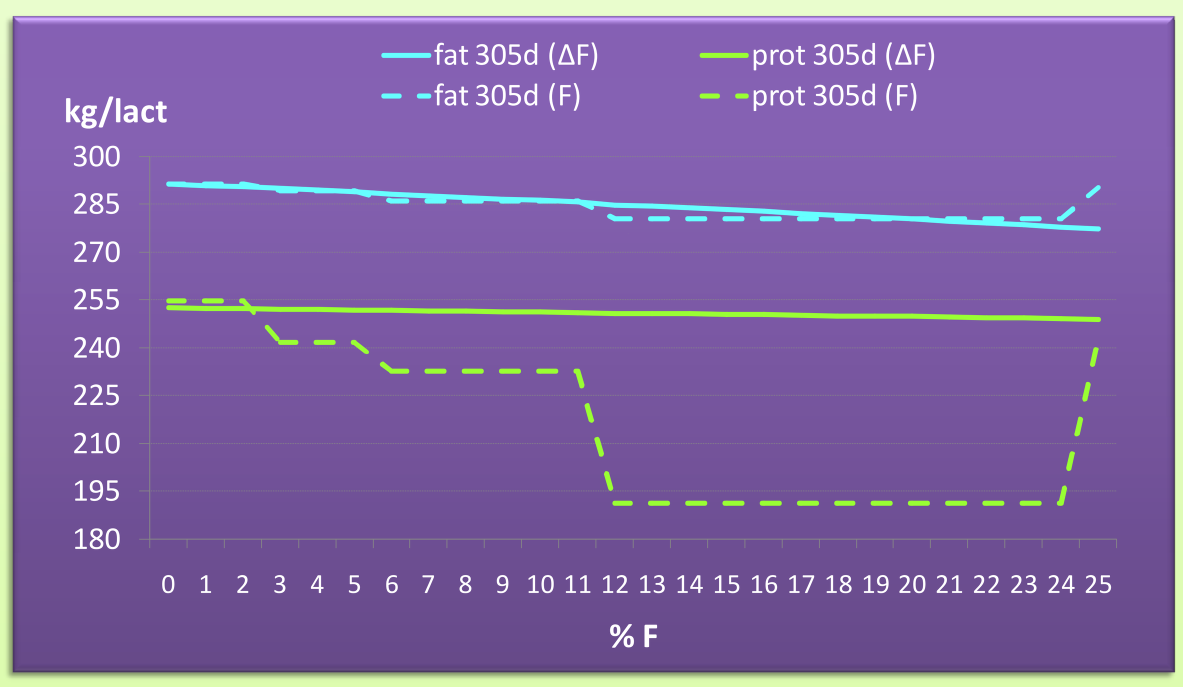

Figure 3. Inbreeding depression for fat and protein yield (in kg per lactation) considering inbreeding coefficient (F) and individual inbreeding rate (ΔF).

CONCLUSIONS

Individual inbreeding rate was the best approach to estimate inbreeding depression on production traits. An effort should be made when mating animals to **avoid common ancestors up to grand-grandsire level.** Otherwise, i.e. when mating animals with common grandsires, the annual genetic progress for milk yield in Spanish Holstein cows (79 kg of milk) could be reduced in a 22% due to inbreeding depression.

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