# Genetic Variability In Mexican Jersey Cattle And Its Potential For Improvement

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## Introduction

Mexican dairy cattle production systems, mainly the intensive ones, depend on importation of germplasm. However, do not all imported sires maintain their genetic superiority in the importer country (Valencia *et al.* (1999); Vargas y Gamboa (2008)). Prediction of breeding values for the Mexican Jersey Cattle Breeders Association (MJCBA) started in 2004. Characterization of the Jersey herd in terms of genetic variability, breeding structure, and breeder´s genetic literacy are needed, in order to design breeding schemes appropriate to Mexican conditions. The objective was to estimate population indicators of genetic variability and to characterize the registered Jersey farms in Mexico.

## Material and methods

**Genetic variability**. Pedigree (n=21,025) and performance data came from 16 herds of the MJCBA. Milk yield (MY; n=5,122), fat (FP; n=4,994) and protein percentage (PP; n= 4,719) records from 2001 to 2007 were analyzed. Milk yield was adjusted to 305 d and mature equivalent (records from DHI-provo). Values that exceeded ± three standard deviations from the mean were discarded. Averages (±standard deviation) for MY, FP and PP were 7,537±2,501 kg, 4.6±0.7% and 3.8±0.6%, respectively. Contemporary groups included herd-year-season subclasses. The AMC program (Roso and Shenkel (2006)) was used to determine connectivity among contemporary groups.

Variance components, breeding values (BV) and inbreeding coefficients (F) were estimated using the MTDFREML program (Boldman *et al.* (1995). Univariate analyses were carried out to identify the model that best fit the data, based on single degrees of freedom likelihood ratio test. The model was: $\mathbf{y} = \mathbf{Xb} + \mathbf{Zg} + \mathbf{Wp} + \mathbf{e}$, where, **y** is a vector of records; **b** is a vector of contemporary groups; **g** is a vector of BV effects; **p** is a vector of cow's permanent environmental effects (except for FP and PP); **e** is a vector or residual effects; and **X**, **Z** and **W** are matrices that associate the respective vectors to **y**. Genetic and F trends were estimated using the REG procedure of SAS (SAS (2002)), through a weighted regression (by number of animals) of average BV and F, on birth year.

**Characterization of Jersey herds**. A census to the 27 members of the MJCBA was performed to characterize their farms, from 2007 to 2008. Response variables were grouped

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as follows: breeder´s attributes (age, scholar years, and livestock experience); herd features (localization, number and type of animals); reproductive management (frequency of use of reproductive technologies); genetic improvement (selection criteria, germplasm flow, and genetic literacy of breeders). Results are shown as frequencies and descriptive statistics.

## Results and discussion

**Genetic variability**. The heritability ($h^2$) for MY was low (Table 1), but within the range (0.21 to 0.33) from other studies (Miglior *et al*. (1992); Vargas and Gamboa (2008)). The $h^2$ for FP and PP were lower than those from other studies (Ahlborn and Dempfle (1992); Miglior *et al*. (1992); Campos *et al*. (1994)), which ranged from 0.42 to 0.53 for FP and from 0.44 to 0.66 for PP.

**Table 1: Variance components for additive ($\sigma^2_g$) permanent environment ($\sigma^2_p$) and residual ($\sigma^2_e$) effects and heritability ($h^2$) estimates for milk yield, and fat and protein content in milk.**

| Trait | $\sigma^2_g$ | $\sigma^2_p$ | $\sigma^2_e$ | $h^2$ |
|---|---|---|---|---|
| Milk yield, kg | 430,120 | 253,240 | 1,163,210 | 0.23±0.03 |
| Fat, % | 0.058 | | 0.212 | 0.22±0.02 |
| Protein, % | 0.048 | | 0.149 | 0.24±0.02 |

The lower $h^2$ in the Mexican Jersey breed may be due to factors as: diversity in environmental and management conditions among herds; amount and quality of records; and differences in estimation procedures. Biscarini *et al*. (2003) indicated that their low $h^2$ may be due to the size of the population and the large amount of missing pedigree data. Guo *et al*. (2002) estimated that the permanent environmental variance and its proportion to the phenotypic variance increased with calving number, and $h^2$ decreased.

Genetic trend for MY was positive until 2003, tending to reduce afterward; the opposite was true for FP and PP (Figure 1). Annual rates of changes in breeding values were small and positive for MY (0.14%) and negative for FP and PP (-0.06% and -0.20%). Similar genetic trends were found by Vargas and Gamboa (2008), and larger trends (0.57 and 0.66%) by CDN (2009) and AIPL (2009).

Inbreeding levels (1.7 and 2.8% for all and inbred animals) were low, but with 63% of inbred animals. The F levels are within the rage (1.2 to 3.3%) of Vargas and Gamboa (2008) and Miglior *et al*. (1992). Recently, F levels have increased in USA (6.8%; Gulisija *et al*. (2007)) and Canada (4.8%; Sewalem *et al*. (2006)). Annual rate of F was 0.1% and within the range (0.05 to 0.3%) reported by Vargas and Gamboa (2008) and Thompson *et al*. (2000).

**Characterization of the Jersey herds**. Average breeder's age was 47 yrs and 12 yrs of experience as breeders (24 yr as cattlemen); they had 15 yrs of school, and 67% had an undergraduate career. These results suggest that Jersey breeders have experience and breeding literacy to implement new technologies in their herds. Similar and lower age and scholar years were found in other local studies (Cervantes (2001); Espinosa *et al*. (2004)). Current Jersey animals were developed from Mexican (48%), Canadian (26%), Australian

(15%) and American (4%) herds. They are located in dry (56%), temperate (19%), and warm (26%) climates. Average herd size and percentage of cows in testing programs were 158 and 54, which was larger than in Canada (71 and 72.3; CDIC (2009)), but smaller than in New Zealand (351 and 71.5; LIC (2007-2008)), and in USA (188 and 48.3; AIPL (2009)).

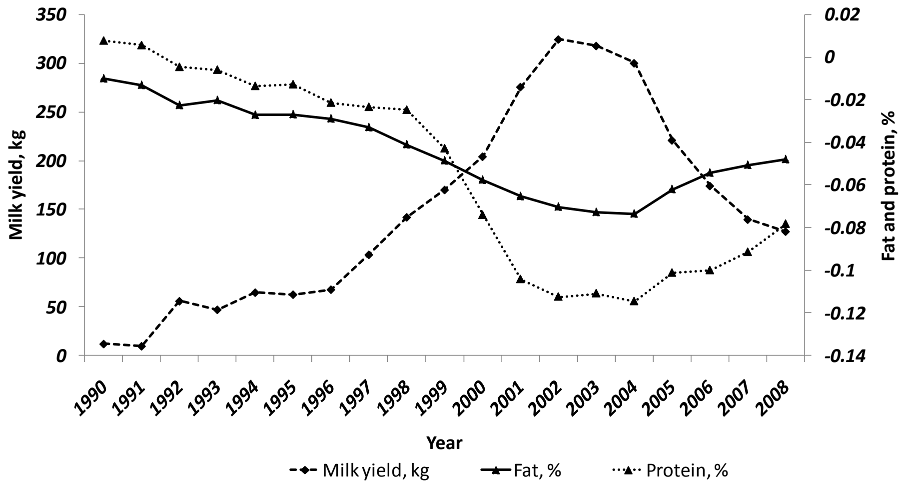


**Figure 1: Estimated genetic trends for milk yield, and fat and protein percentage in Mexican Jersey cattle.**

All herds use AI to breed an average of 87% of the cows, and about half of the herds use natural mating in around 25% of the services. Embryo transfer (26%) and use of sexed semen (11%) technologies are less utilized. Animal identification is used in all herds and 67% of them are enrolled in performance recording programs; few breeders (18%) use crossbreeding and 14% use the genetic evaluations of animals as selection criteria.

The selection criteria most used in females was for type traits (94%), whereas in males the most frequent criteria were for conformation traits (68%), productive performance of relatives (64%) and pedigree (64%) information. Semen selection was based on genetic evaluations (78%), mainly looking at milk yield (92%), and mammary (88%) and feet and legs (80%) systems.

Mating criteria were: avoiding inbreeding (59%); getting better balanced conformation traits in cows (48%); and using specific bulls for repeated non pregnant cows (41%). Very few breeders buy, produce or sell sires and semen (7, 22 or 8%, respectively); however, most of them (89%) buy semen. Main semen supplier companies are Alta Genetics (67%) and Semex (48%). The most important local herd (Rancho San Carlos) that sells semen, covers 15% of the herds to mate 75% of the cows. Replacement heifers were from Mexico (73%), Canada (27%) and the US (20%). Breeders consider the US and Canada as the most important suppliers of Jersey germplasm. These findings agree with other studies (Cienfuegos-Rivas *et al.* (1999); Valencia *et al.* (1999)) that indicate that dairy cattle genetic improvement in Mexico is based on importation from the US and Canada.

## Conclusion

Even when there is enough variability for genetic improvement in the Mexican Jersey cattle population, small genetic trends were observed for milk yield. Most Mexican Jersey breeders depend on semen importation from the United States and Canada. Jersey cattle breeders have experience and breeding literacy to potentially implement breeding strategies based on current genetic evaluations.

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