

GENETIC PARAMETERS OF MILK YIELD AND INBREEDING RATE IN HOLSTEIN HERDS FROM BRAZIL

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INTRODUCTION

Brazil has the third bovine herd of the world in number of animals. Among the specialized dairy breed the Holstein is the most representative in terms of milk production, with productions that get to reach values similar to the observed at developed countries. According to the Brazilian Holstein Herd Book, 104.382 animals was in milking recording in 1999, with average of milk yield of 6.799 kg (2X and 305 days) and of 7.532 kg the mature age (2X and 305 days). About 84,0 % of the Holstein dairy herds are located in the states of São Paulo, Paraná and Minas Gerais. The selection based on the estimates of the genetic values of the sires for trait used as selection criteria cause the increase of the inbreeding rates, because relatives animals has similar genetic value allowing the relatives co-selection to be frequent. Several algorithms that allow the estimate of the inbreeding coefficient are being used when the pedigrees of all the animals should be used (Vanraden and Hoeschele, 1990 ; Meuwissen and Luo, 1992 ; Miglior *et al.*, 1992 ; Bijma, 2000). Due the difficulty to have the complete genealogy registrations, Vanraden and Hoeschele (1990) and Bijma (2000) developed a algorithm to estimate the inbreeding rate with data lost. A negative action of the inbreeding about the production of milk has been reported by literature (Hodges *et al.*, 1979 ; Hudson and Van Vleck, 1984 ; Shorts *et al.*, 1992 ; Vanraden *et al.*, 1992 ; Bijma, 2000). This study had as objectives to estimate the genetics parameters of milk yield and the inbreeding rate in Holstein herds maintained in the Southeast region of Brazil

MATERIAL AND METHODS

Data from the Brazilian Holstein herds were analyzed (163 389 lactations of 82 724 cows daughters of 6 835 bulls from different lines and origins distributed in 1 310 herds and calved between 1980 and 1999). The herds are maintained predominantly of the Southeast region of the country. The management adopted in these herds are very variable, due to the different production systems which one are submitted. For the corrections and consistencies of the data it was used the available procedures in the SAS program (Statistical Analysis System, 1992). With the imposed restrictions, the analysis file was reduced to 85 764 lactations of 45 680 cows, daughters of 792 bulls, and distributed in 767 herds. The variance components and inbreeding coefficients, were estimated by Restricted Maximum Likelihood method (REML), under an animal model, through the program MTDFREML (Multiple Trait Derivative-Free Restricted Maximum Likelihood) described by Boldman *et al.* (1993). The analyses of the model I, only 974 inbred animals were computed. Analyses were accomplished under sire model, just with these animals. This model was used, due to difficulty to use in the execution of genetic evaluations under animal model, due to the difficulties to obtaining the complete

genealogy of the animals. Then a comparison took place between two sire models, the Model II where was not considered the inbreeding coefficients ; and another where this effect was included (Model III). This model III was also analyzed by Least Squares method, using the procedure available GLM of in the SAS (Statistical Analysis System, 1992), for verify significant level of the inbreeding coefficient on the production of milk, under sire model previously described.

RESULTS AND DISCUSSION

The average to the milk yield was 6,203 kg with standard deviation of 1,652 kg. The estimates of the variance components and of the heritability coefficient, obtained in this study for the milk production are presented in the table 1, According to the model I, analysis realized under animal model, using all the data, while, that the model II refers to the analysis using the sire model, not considering the inbreeding coefficient. The model III, refers to the analysis where the inbreeding coefficient was considered. The values obtained for the heritability estimates were reasonable, since 34 % (I model I), 20 % (model II) and 19 % (model III) It was possible to verify that it part of the variations totals is genetic additive. These results are similar to several citations in the literature, (Zambianchi *et al.*, (1999) ; Freitas *et al.*, (1999) ; Marion, (2000)), that used the same methodology. The values obtained to the repeatability were 0.51, 0.25 and 0.23 for the models I, II and III respectively. Also, It was possible to verify in the table 1, that when it was considered the inbreeding coefficient (model III), there was a slight reduction of the additive genetic variance, and an increase of the variance due to the permanent effect.

Table 1. Number of lactations, estimates of the variance components and heritability to the milk yield (kg) and 305 days, in the models I, II and III

Models	N	σ_a^2	σ_{pe}^2	σ_e^2	h^2
Model I	85,764	546,836.50	20.21	1,070,238.27	0.34 (0.02)*
Model II	913	535,610.57	17.13	2,179,868.32	0.20
Model III	913	505,944.41	45.83	2,189,659.33	0.19

* between bracket the standard error of the heritability

The average value of the inbreeding coefficient was of 0.02, close to the mentioned by Miglior (1994) that was of 0.07. In the table 2 the classification of the first 10 sires is observed according to the PTAs values (predicted transmission ability), in the models II and III. It observed that there was change in the classification of these sires when it was compared the two models. Important to point out that, in most of the analyzed animals, when it was considered the inbreeding coefficient in the model, the value of PTA decreased, showing a tendency of overestimation of those values when this effect is not considered, therefore, the inclusion of the inbreeding coefficient, in some way interferes in the estimates of the final genetic values.

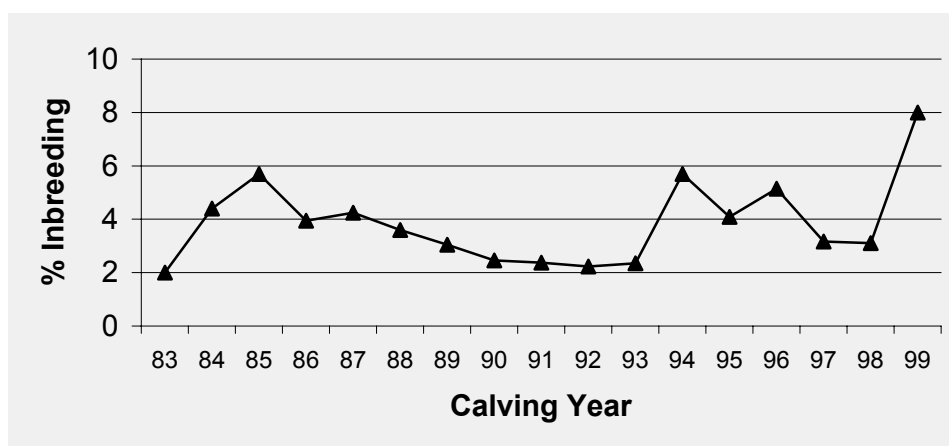
Table 2. Classification of the first 10 animals according to the values of the predicted transmission ability (PTA), using the model II and III

Animal ID	PTA (Model II)	PTA (Model III) ^A
1) 84049	846.67	720.44 (1)
2) 71985	560.90	491.05 (2)
3) 74325	460.79	371.86 (6)
4) 40522	451.32	385.40 (5)
5) 73930	442.45	361.48 (8)
6) 85468	394.68	451.40 (3)
7) 62356	389.65	393.32 (4)
8) 38324	366.36	357.12 (9)
9) 74324	351.33	368.70 (7)
10) 62790	340.97	275.02 (10)

^A between bracket it is the rank of the same animals when the inbreeding rate was considered in the model.

In the figure 1 are represented the behavior of the inbreeding rates graphically along the studied period. There were an increase of the inbreeding coefficient observed in the period from 83 to 85, as well as, soon after a decline that is prolonged up to 93, and finally a flotation up to 99, similar tendency observed by Miglior (1994), that studied the same breed in Canada.

Figure 1. Inbreeding rate (%) among the animals studied in the period 1983-1999



CONCLUSION

The values obtained to the heritability of milk yield are indicative of the possibility of genetic improvement through selection, The low value obtained to the inbreeding coefficient (0.02), was not significant on milk yield, although has altered the values of PTAs, and the rank of the studied animals. However more researches should be carry out with a larger number of data to confirm or not the present results.

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REFERENCES

- Bijma, P. (2000) PhD Thesis, Animal Breeding and Genetics, Department Animal of Sciences, Wageningen University, Wageningen, The Netherlands.
- Boldman, K.G., Kriese, L.A., Van Vleck, L.D. and Kachan, S.D. (1993) Lincoln, Department of Agriculture, Agricultural Research Service, 120 p.
- Freitas, A.F. De, Durães, M.C., Teixeira, N.M., Valente, J. and Junior, M.N. (1999) In "Reunião da Sociedade Brasileira de Zootecnia", Porto Alegre, Rs, p.150.
- Hodges, J., Tannen, L., McGillivray, B.J., Hiley, P.G. and Ellis, S. (1979) *Can. J. Anim. Sci.* **59** : 153-158.
- Hudson, G.F.S. and Van Vleck, L.D. (1984) *J. Dairy Sci.* **67** : 161-170.
- Marion, A.E. (2000) Ms Dissertation, Universidade Federal de Santa Maria, R.S., Brazil.
- Meuwissen, T.H.E. and Luo, Z. (1992) *Genet. Sel. Evol.* **24** : 305-309.
- Miglior, F., Sckotnicki, B. and Burnside, E. (1992) *J. Dairy Sci.* **75** : 1112-1118.
- Miglior, F. (1994) PhD Thesis, Guelph University of Guelph.
- SAS Institute Inc. SAS/STATTM(1992) SAS 6.08 ed. Cary, SAS Institute Inc.
- Short, T.H., Lawlor, T.J. and Everett, R.W. (1992) *J. Dairy Sci.* **77** : 648-658.
- Smith, L.A., Cassel, B.G. and Pearson, R.E. (1998) *J. Dairy Sci.* **81** : 2729-2737.
- Vanraden, P.M. and Hoeschele, I. (1990) *J. Dairy Sci.* **73** (Suppl. 1) : 233.
- Vanraden, P.M., Lawlor, T.J., Short, T.H. and Hoeschele, I. (1992) *J. Dairy Sci.* **75** : 2892-2901.
- Vonkrosigk, C.M. and Lush, J.L. (1958) *J. Dairy Sci.* **41** : 105-113.
- Young, C.W. (1973) *J. Dairy Sci.* **56** : 659.
- Zambianchi, A.R., Freitas, M.A.R. and Pereira, C.S. (1999) *Rev. Bras. Zootec.* **28** : 1263-1267.