INTERBULL MEETING, AARHUS, DENMARK, AUGUST 19-20, 1993

Herdlife in the Italian Holstein Friesian

A. BAGNATO
Istituto di Zootecnica
Facoltà di Medicina Veterinaria
Via Celoria 10, 20133 Milano, Italy

INTRODUCTION

Genetic selection in domestic populations has the general purpose to increase the productivity of a breed or more generally of a population. In economic terms this can be obtained both increasing the income by producing more (more milk in dairy populations), or decreasing costs acting on traits that represent costs, like reproductive or health traits. True herd life (**THL**) has been defined by Ducrocq (3) as the ability of a cow to survive in a herd or the capability to delay voluntary and involuntary culling, while functional herd life (**FHL**) has been defined as the ability of a cow to avoid involuntary culling: then FHL would be a measure of the ability of a cow to avoid culling independently from production. In selection programs FHL could be used as indicator of traits that represent costs, while milk production represents the herd income. The relative economic value for milk production to herd life was estimated 3.2 to 1 by Allaire and Gibson (1) for North American economic conditions. Researchers (2, 7) have recently proposed to measure herd life indirectly using type traits which are available with the first genetic evaluation of the animal. A different approach has been proposed by Everett et al. (4) measuring stayability of a cow as presence or absence in the herd at a certain age.

Relationships between different stayability traits, true and functional herd life, type traits, and milk production up to 305 d in first lactation in Italian Holstein Friesian cattle has been evaluated in this study.

MATERIALS AND METHOD

Data refer to 158,428 records of first parity cows scored by classifiers of the National Breeder Association of Italian Friesian between 1984 and 1988. THL was defined as months from first calving to disposal. Because culling date was not available, the criteria indicated by Foster et al. (5) was used to determine if the cow had left the herd (no events before 540 d from last recorded calving). Only cows which have had the opportunity to survive to 48 mo of THL were included in the analysis. Stayability traits were defined as survival (1 survived, 0 not present) at 17 (**S17**), 28 (**S28**), 41 (**S41**) months of productive life. Type traits, all scored linearly from 1 to 50 (6), were: stature, chest width, body depth, angularity, rump angle (side view), rump length, rump width, rear legs (side view), foot angle, fore udder attachment, rear udder height, rear udder width, central ligament, udder depth, teats. Final score was also included in the analysis.

A multiple trait sire model was used to estimate genetic correlations simultaneously for milk production, THL, FHL, stayability and type traits. A canonical transformation was used with the same design matrix for all the traits analysed. The fixed effect included in the model were herd-year of classification, classifier, age at first calving, month at first calving, stage of lactation at classification, and genetic group of the sire. Genetic groups were assigned according to birth date and origin of sire. The relationship matrix was included in the analysis. All 850 sire included in the analysis had at least 10 daughters in 10 different herd-year. As proposed by other authors (2, 4, 7), rank of cow within herd for milk yield was used to adjust THL for milk production. Cows were ranked in percentiles within herd-year according to their first lactation mature equivalent milk production. Also cows eliminated by editing were included in determining percentiles. Regression of percentile rank of a cow on THL was estimated with a univariate sire model including same fixed effects as described earlier. In attempt to estimate FHL, the value of regression estimate (.137 mo per percentile) times the relative percentile rank was subtracted from THL.

RESULTS

Average THL was 32.1 months, with an average age at first calving of 29.1 months. In Table 1 heritabilities and genetic correlations between milk production THL, FHL, S17, S28, and S41 are shown.

Table 1. Heritabilities (diagonal) and genetic correlations between milk production, stayability and survival traits[1].

	MP	THL	FHL	S17	S28	S41
MP	.25					
THL	.57	.04				
FHL	.02	.83	.03			
S17	.61	.95	.74	.02		
S28	.57	.98	.80	.96	.03	
S41	.47	.99	.89	.92	.96	.03

1 MP = milk production in first lactation
THL = total herd life
FHL = functional herd life
S17 = survival at 17 months of THL
S28 = survival at 28 months of THL
S41 = survival at 41 months of THL

Heritabilities for survival traits is low, ranging from .02 for S17 to .04 for THL. This is in agreement with results found by others (2,7). Correlation between MP and THL (.57) indicates that cows with higher milk production have greater opportunity to survive in the herd. After accounting for production, correlation between MP and FHL (.02) indicates that functional stayability as estimated in this study is independent from milk production. Decreasing genetic correlations between MP and S17, S28, S41 denote that importance of milk production in culling decisions became smaller: health reasons may play an increasing role in disposal as the age of cows increases. Low correlation between THL, and FHL indicates that THL and FHL are measures of different survival traits.

In Table 2 genetic correlations between milk production, THL, FHL, S17, S28, S41 and type traits are shown.

Dimensional traits (stature, chest width, and body depth) do not appear to be correlated with milk production. Angularity and rear udder width are highly correlated with milk production, with genetic correlations of .47 and .51 respectively. The negative correlations between udder depth, fore udder attachment and MP, -.37 and -.09 respectively, indicate that selection for milk production can be detrimental for udder conformation.

Correlations between THL and udder traits are moderate except for fore udder and udder depth which are smaller and reflect the positive relationship between THL and milk production. Size related traits indicate that smaller cows should have more opportunity to survive.

Correlations between S17, S28, S41 and type traits are mainly consistent with those between THL and type traits.

Final score is not a good indicator of FHL. Correlations between FHL and stature, chest width, and body depth are of same magnitude and direction of those between the same dimensional traits and THL because milk production resulted not affected by dimensional traits. Boldmann et al. (2) and Short et Lawlor (7) in US Holstein found a moderately negative association between FHL and dimensional traits.

Table 2: Genetic correlations between milk production, survival traits and type traits.

Type traits	MP	THL	FHL	S17	S28	S41
Final score	.30	.17	.01	.08	.26	.12
Stature	-.07	-.16	-.15	-.22	-.05	-.15
Chest width	-.08	-.28	-.29	-.35	-.22	-.29
Body depth	.03	-.23	-.30	-.31	-.18	-.27
Angularity	.47	.31	.06	.30	.37	.25
Rump angle	.07	.13	.12	.13	.11	.11
Rump length	-.06	-.03	.01	-.12	.06	.01
Rump width	.05	-.14	-.20	-.18	-.10	-.13
Legs	.17	-.02	-.16	.03	-.01	-.07
Foot angle	.05	-.02	-.05	-.11	.00	-.04
Fore udder	-.09	.11	.20	-.03	.16	.13
Rear udder height	.29	.24	.11	.18	.27	.21
Rear udder width	.51	.26	-.02	.22	.27	.18
Central ligament	.21	.30	.22	.24	.32	.30
Udder depth	-.37	.04	.31	-.08	.09	.13
Teats	.06	.13	.12	.09	.14	.13

[1] MP = milk production in first lactation
THL = total herd life
FHL = functional herd life
S17 = survival at 17 months of THL
S28 = survival at 28 months of THL
S41 = survival at 41 months of THL

Fore udder, and udder depth, negatively correlated with MP, after accounting for milk production are positively associated with FHL, .20 and .31 respectively. Also correlation between central ligament and FHL is moderately high (.20). Since udder depth is related with the dimensional characteristics a lower udder will produce more milk but will be more likely to have health related problems as the cow get older. Correlations of udder depth and fore udder attachment with S17, S28, S41 indicate that health related problems became more important in culling decisions as parity increases. Foot angle shows a correlation with longevity traits close to zero while legs show a correlation with FHL of -.16. Quadratic relationships were investigated and an intermediate score resulted optimum for foot angle. Possibly foot angle should be analysed as related to rear legs.

CONCLUSIONS

Milk production was the single trait most important in determining longevity. Genetic correlations of FHL with type traits show that an indirect selection for longevity can be addressed by using udder traits or dimensional traits which result moderately correlated with functional survival.

REFERENCES

1) Allaire, F. R., and J. P. Gibson. 1992. Genetic value of herd life adjusted for milk production. J. Dairy Sci. 75:1349.

2) Boldmann, K. G., A. E. Freeman, B. L. Harris, and A. L. Kuck. 1992. Prediction of sire transmitting abilities for herd life from transmitting abilities for linear type traits. J. Dairy Sci. 75:552.

3) Ducrocq, V., R. L. Quaas, E. J. Pollak, and G. Casella. 1988. Length of productive life of dairy cows. 1. Justification of a Weibull model. J. Dairy Sci. 71:3061.

4) Everett, R. W., J. F. Keown, and E. E. Clapp. 1976. Production and Stayability trends in dairy cattle. J. Dairy Sci. 59:1532.

5) Foster, W. W., A. E. Freeman, P. J. Berger, and A. Kuck. 1989. Association of type traits scored linearly with production and herdlife of Holsteins. J. Dairy Sci. 72:2651.

6) National Association of Breeders of Italian Friesian. 1993. Cosa Valgono.

7) Short, T. H., and T. J. Lawlor. 1992. Genetic parameters of conformation traits milk yield and herd life in Holsteins. J. Dairy Sci. 75:1987.