ГОВЕДОВЪДСТВО

CORRELATIONS BETWEEN LENGTH OF PRODUCTIVE LIFE, MILK PRODUCTION AND CONFORMATION TRAITS IN THE LITHUANIAN BLACK-AND-WHITE COWS POPULATION

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The length of productive life (LPL) was defined as the time from first calving of a heifer to the time of a cow culling or death (**Meszaros et al.,** 2008, **Wolfova et al,** 2007). Longer productive life affects overall profitability of milk production by reducing replacement costs and increasing the proportion of mature, high-producing cows in the herd. Dairy cows leave herds for many reasons, including low milk yield, mastitis and other health disorders, reproductive failure, sales for dairy purposes and death (**Ducrocq,** 1994, **Krastev and Kistanova,** 2001). During the past 10 years, researchers in the all countries have become increasingly interested in measuring the genetic ability of a dairy cow to resist culling (**Ducrocq,** 1994, **Hansen et al.,** 1999, **Krastev and Kistanova,** 2001, **Martinez et al.,** 2004, **Tsuruta et al,** 2004).

Meszaros et al. (2008) estimated that cows with extremely low class of milk production had a five times a higher risk of culling than cows with average milk production. Age at first calving is a factor of minor importance for the length of productive life. According to **Sewalem et al.** (2005) increased risk of culling was observed for cows that required hard pull, calved small calves, or dead calves. Moreover, cows that require more services per conception, a longer interval between first service to conception, an interval between calving to first service greather than 90 d, and increased days open were greater risk of being culled. Similar findings were published by **Vollema and Groen** (1997) and **Sewalem et al.** (2005).

Genetic relationships among milk yield, fat, protein, body size composite and udder traits have an impact on the value of length of productive life for any breeding programmes. Some dairy producers believe that larger cows have more body capacity to consume more feed, which in turn might allow cows to produce greatest volumes milk, but some dairy producers are unsatisfied with body size of heifers at firs calving because of poor heifer growth and health problems during calving. Cows with the small body dimensions had shorter legs and udders were closer to the ground so they had more functional problems for milk removal and more predisposed infections and mastitis. However, the legs and feet of large cows supported more body weight than did the legs and feet of small line cows and, consequently, could be expected to be under more stress and more prone to injury. Also, larger cows have a higher center of gravity than do small cows and might be more likely to slip and fall (**Hansen et al.,** 1999).

Increases in genetic merit for milk yield are associated with increases in mobilization of body reserves (**Beerda et al.,** 2007). Additionally, successfully manipulating body reserves is generally acknowledged as an important management factor, influencing animal health, milk production, and reproduction in the dairy cow (**Buckley et al.,** 2003). Therefore, to maximize genetic improvement, selection must be directed toward an appropriate breeding goal (**Wolfova et al,** 2007). In addition, future breeding goals must consider traits associated with animal welfare, such as longevity and health, because, ignoring these will reduce farm profit, increase the environmental impact of dairy farming, and diminish

consumer demand for animal products (Stott et al., 2005)

The aim of this study was to estimate genetic (r_g) and phenotypic (r_p) correlations between length of productive life and type traits in Lithuanian Black-and-White cows' population.

MATERIAL AND METHODS

The data of cows' conformation evaluation were extracted from national database. The methodology of linear type evaluation for cows in Lithuania meets the ICAR (International committee for Animal recording) standards and EU directive (77/504, 86/130, 87/328, 94/515). The following traits of cows are evaluated: height, stoutness, body depth, chest width, dairy type, rump width, rump angle, rear leg set angle, rear leg form, heel joint, hoof height, hoof tarsus angle. The national schemes for appraisal of Lithuanian Black-and-White cattle include seven traits of udder: fore udder attachment, rear height, cleft, depth, teats placement, length and thickness. Linear assessment of each trait is scored between the biological extremes on a scale of 1 to 9.

The productive live (measured in moths) data set consisted of 6120 registered Lithuanian Black- and -White cows between 1996 and 2007 in Lithuanian State enterprise's Agri-Information and Rural Business Center.

The statistical investigation was carried out using "R 2.1.0" package (http://www.r-project.org/) and PEST software (**Groeneveld,** 1998). Analysis was performed using a Weibull proportional hazard model. The Weibull model is very flexible so it is easy to use for interpretation of many effects (**Ducrocq,** 1994). The following effects were included in the model - fixed: herd-year-season, sire, sire dam, age at first calving, lactation number; lactation phase, herd size, herd change; random: cow's milk production; cow's fat and protein production, herd's average milk production, herd's average fat and protein production.

RESULTS AND DISCUSSION

Genetic and phenotypic correlations among length of productive life and production traits were presented in table 1. Correlations among milk yields, milk fat and protein traits with length of productive life were positive. Correlation length of productive life with milk was similar to the correlation with protein yield. The results shown in table 1, demonstrated the milk production traits having positive influence on productive live of cows ($P<0.001$). Tsuruta et al. (2004) described genetic negative but low correlation of milk with productive life.

Today, multiple dairy cattle breeding programs use type traits as early predictors of longevity. Various studies have quantified the importance and the impact of type traits on longevity in dairy cattle (**Larroque and Ducrocq,** 2001). Research indicates that dairy cows of moderate size, with functional udders and correct feet and legs are more likely to remain in the herd than cows that lack these characteristics. Numerous studies have addressed the genetic relationships between linear type traits and longevity (**Caraviello et al.,** 2004, **Sewalem et al.,** 2005).

Genetic and phenotypic correlations among length of productive life and exterior traits of cows indicated in table 2. The observed genetic correlations between productive life of cows and type traits are in the range of -0.034 (between productive live and teat's placement) to 0.067 (between productive live and hoot and tarsus angle); phenotypic correlations are in the range of -0.312 (between productive live and depth of udder) to 0.296 (between productive live and stoutness). Negative statistically significant

Table1. **Correlations between productive live and milk production of cows**

Traits	r_g	r_p
Milk, kg	0.011*	0.276***
Fat, kg	0.028**	0.272***
Protein, kg	0.010*	0.274***

P - *< 0.05, **, < 0.01, ***< 0.001

Table 2. **Correlations between length of productive life and conformation traits of cows**

	Traits	Correlation	
		Genetic	Phenotypic
	Height	0.057***	-0.082***
	Stoutness	0.050***	0.296***
	Depth	-0.011*	0.223***
Body size	Width of chest	0.041***	0.172***
	Dairy type	0.078***	0.185***
	Width of rump	-0.066***	0.148***
	Angle of rump	-0.024***	-0.056***
	Rear leg set angle	0.001	-0,105***
	Rear leg form	0.010*	-0.115***
Legs and hoof	Joint of heel	0.040***	0.125***
	Height of hoof	0.034***	0.145***
	Hoof tarsus angle	0.067***	-0.022***
	Fore udder attachment	-0.010*	0.018**
Udder	Rear udder height	-0.017**	0.211***
	Udder cleft	0.024***	0.082***
	Depth of udder	0.006*	-0.312***
	Teat's placement	-0.034*	-0.071***
	Length of teat	0.042*	0.195***
	Teat's thickness	-0.024***	0.172***

P - * < 0.05, **, < 0.01, ***< 0.001

genetic correlations of productive live were found with depth ($P<0.05$), rump width and rump angle ($P<0.001$) of cows, fore udder attachment ($P<0.05$), rear height of udder ($P<0.01$), teats placement ($P<0.05$) and teat thickness ($P<0.001$). Positive statistically significant genetic correlations of productive live were found with height, stoutness, chest width and dairy type ($P<0.001$), heel joint, hoof height, hoof tarsus angle and udder clef ($P<0.001$), udder depth and teats length ($P<0.05$). The approximated genetic correlation estimate between length of productive life and body size dimensions and legs traits was somewhat stronger than that between udder traits. **Perez-Cabal et al.** (2006) reported that the most influential type trait on profit, on length of productive life adjusted for production was feet and legs.

Positive phenotypic relationships between length of productive life and stoutness of cow, depth, width of chest and rump, and dairy type were determined, but with others body traits were noticed negative correlations ($P<0.001$). Phenotypic correlations between length of productive life and joint of heel, height of hoof were positive ($P<0.001$). Relationship length of productive life with other legs and hoof traits was negative but significantly ($P<0.001$). Phenotypic correlations between length of productive life and dept of udder, teat's placement were negative ($P<0.001$), but relations with other udder traits were positive ($P<0.01$-0.001).

Similar results of genetic correlations between length of productive life and body size composition traits were reported in the literature (**Larroque and Ducrocq,** 2001, **Perez-Cabal et al.** 2006). Investigations of relationships of length of productive life with legs and hoof composition traits were similar to most authors **Setati et al.** (2004), **Vacek et al.** (2006). Significant genetic correlations between length of productive life and udder composition traits were in agreement with results presented in the international studies - **Vollema and Groen** (1997), **Perez-Cabal et al.** (2006), **Schneider et al.** (2003),

and **Wall et al.** (2005). Genetic and phenotypic correlations between length of productive life and exterior traits were previously analogical results presented in literature (**Larroque and Ducrocq,** 2001, **Perez-Cabal et al.** 2006, **Sewalem et al.**, 2005). Generally, our results are in agreement with correlations published by **Vollema and Groen** (1997), **Vacek et al.** (2006) and others. The production and most of the conformation traits showed significant effect on productive live of cows.

CONCLUSION

The results of genetic and phenotypic relationships demonstrated the milk production traits having positive influence on productive live of cows ($P<0.001$). The relationships between most of the conformation traits and productive live of cows were significant. The observed genetic correlations between productive life of cows and type traits are in the range of -0.034 (between productive live and teat's placement) to 0.067 (between productive live and hoot and tarsus angle); phenotypic correlations - in range of -0.312 (between productive live and depth of udder) to 0.296 (between productive live and stoutness).

REFERENCES

1. **Beerda, B., W. Ouweltjes, L. Sebek, J. J. Windig, R. F. Veerkamp,** 2007. Journal of Dairy Science, No 90, 219-228.
2. **Buckley, F., K. O'Sullivan, J. F. Mee, R. D. Evans, P. Dilbon,** 2003. Journal of Dairy Science, No 86, 2308-2319.
3. **Caraviello, D. Z., K. A. Weigel, D. Gianola,** 2004. Journal of Dairy Science, No 87, 2677-2686.
4. **Ducrocq, V.,** 1994. Journal of Dairy Science, No 77, 855-866.
5. **Groeneveld, E.,** 1998. PEST Users' Guide, Institut fur Tierzuchtung and Tierverhalten. Matriensee, , 91 p.
6. **Hansen, L. B., J. B. Cole, G. D. Marx, A. J. Seykora,** 1999. Journal of Dairy Science, No 82, 795-801.
7. **Krastev, K., E. Kistanova,** 2001. Biotechnology in Animal husbandry, 17:3-4, p. 29-32
8. **Larroque, H., V. Ducrocq,** 2001.Relationships between type and longevity in the Holstein breed. Genetics Selection Evolution, No 33 (1), 39-59.
9. **Martinez, G. E., R. M. Koch, L. V. Cundiff, K. E. Gregory, L. D. Van Vleck,** 2004. Journal of Animal Science, No 82, 1912-1918.
10. **Meszaros, G., J. Wolf, O. Kadlecik,** 2008. Czech Journal of Animal Science, No 3, 91-97.
11. **Perez-Cabal, M. A., C. Garcia, O. Gonzalez-Recio, R. Alenda,** 2006. Journal of Dairy Science, No 89 (5), 1776-1783.
12. **Schneider, P. M., J. W. Durr, R. I. Cue, H. G. Monardes,** 2003. Journal of Dairy Science, No 86(12), 4083-4089.
13. **Setati, M. M., D. Norris, C. B. Banga, K. Benyi,** 2004. Tropical Animal Health and Production, No 36 (8), 807-814.
14. **Sewalem, A., G. J. Kistemaker, B .J. Van Doormaal,** 2005. Journal of Dairy Science, No 88 (4), 1552-1560.
15. **Stott, A, C. Milne, P. Goddard, A. Waterhouse,** 2005. Livestock Production Science, 97, No 2, 161 - 171.
16. **Tsuruta, S., I. Misztal, J. Lawlor,** 2004. Journal of Dairy Science, No 87, 1457-1468.
17. **Vacek M., M. Stiokpkova, E. Nemcova, J. Bouska,** 2006. Czech Journal of Animal Science, 51, No 8, 327-333.
18. **Vollema, A. R., A. F. Groen,** 1997. Journal of Dairy Science, No 81, 3006-3014.
19. **Wall, E., I. M. White, M. P. Coffey, S. Brotherstone,** 2005. Journal of Dairy Science, No 88 (4), 1521-1528.
20. **Wolfova, M., J. Wolf, J. Kvapilik, J. Kica,** 2007. Journal of Dairy Science, No 90, 2442-2455.

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SUMMARY

The objective of this study was to determine genetic and phenotypic correlations between length of productive life and milk production, conformation traits in Lithuanian Black-and-White cows' population. The conformations and productive live data set consisted of 6120 registered Lithuanian Black- and -White cows between years 1996 and 2007, inclusive in Lithuanian State enterprise's Agri-Information and Rural Business Center. Analysis was performed using a Weibull proportional hazard model. The following effects were included in the model - fixed: herd-year-season, sire, sire dam, age at first calving, lactation number; lactation phase, herd size, herd change; random: cow's milk production; cow's fat and protein production, herd's average milk production, herd's average fat and protein production. The results of genetic and phenotypic relationships demonstrated the milk production traits having positive influence on productive live of cows ($P<0.001$). The relationships between most of the conformation traits and productive live of cows were significant. The observed genetic correlations between productive life of cows and type traits are in the range of -0.034 (between productive live and teat's placement) to 0.067 (between productive live and hoot and tarsus angle); phenotypic correlations - in range of -0.312 (between productive live and depth of udder) to 0.296 (between productive live and stoutness).

Key words: *cows, length of productive life, type traits, correlation*