Evaluation of Reproduction Traits in Selected Breeding Herds of Slovak Simmental Dairy Cows by Breeding Type

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Abstract
The aim this work was analyse reproduction traits in selected breeding herds Slovak Simmental dairy cows in the period 2012 to 2016 by breeding type (S_0, S_1, S_2) the results for dairy cows: DFS, DO, NIC and CI. The basic statistical analysis were analysed using the SAS version 9.3 (TS1M2). For the actual computation a linear model with fixed effects was used: $y_{ijklm} = \mu + HYS_i + b_j + c_k + e_{ijkl}$, where: μ = mean value, HYS_i, b_j = sire, c_k = effect of bull, e_{ijkl} = residual error. The basic traits of reproduction traits (DFS, DO, NIC, CI) in selected breeding herds Slovak Simmental dairy cows were 78.55 days, 120.83 days, 407.02 and 2.14 times for S_0, 78.62 days, 124.82 days, 408.76 and 2.04 times for S_1, and 80.99 days, 124.07 days, 410.90 and 2.20 times for S_2. The linear model to represent coefficient determination R^2 = 0.482750 % for DFS, R^2 = 0.435010 % for DO, R^2 = 0.345971 % NIC and R^2 = 0.482750 % CI with all fixed effects. The analyses by the effect were the highest effect of HYS than effect of sire. These effects were statistically high significant *(P<0.0001)*.

Keywords: Slovak Simmental cattle, dairy cows, reproduction traits, breeding type, coefficients of determination, correlations.

1. Introduction

Reproduction traits are considered very important because of their impact on the economy of dairy cattle breeding [1, 2].
Female fertility is affected by many factors, e.g. return to oestrus cycle after calving, visible oestrus**,** success of artificial insemination, success of conception, nutrition, breeding conditions and season of calving, time to first heat and milk production [3, 4]. Reproductive traits are quantitative traits; they are regulated by several genes and are highly influenced by environment which causes a large phenotypic variability.
In general, the reproduction traits are heredity but only to a small degree [5, 6].
Evaluation of reproduction traits in dairy cows shows many authors for example [7-10].
The reproduction traits in population dairy cows of the Slovak republic were evaluation Riecka et al. [11], Bujko et al. [12-14] and others Kasarda et al. [15], Gábor et al. [16].
Correlation between reproduction traits shows results by Ríos-Utrera et al. [18], Andersen-Ranberg et al. [19] and Sewalem, Kistemaker [20].
The aim of this study was to find relation between reproduction traits in dairy cows Slovak Simmental cattle.

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2. Materials and methods

The material for evaluation traits in breeding herds of Slovak Simmental cattle between 2012 and 2016 were received from of Breeding Service of Slovak republic for period [21].

We observed subsequent results in dairy cows of 3 463 Slovak Simmental cattle: days to first service (DFS), days open (DO), number of inseminations per conception (NIC) and calving interval (CI).

We divided dairy cows only breed-type S_0 - cows with genetic proportion of pure Slovak Simmental blood into 87.5 %. %, S_1 - cows with genetic proportion of pure Slovak Simmental blood from 75 % to 87.4 %, S_2 - cows with genetic proportion of pure Slovak Simmental blood from 50 % to 74.9 %.

The basic statistics analysis of reproduction traits: days to first service (DFS), days open (DO), number of inseminations per conception (NIC) and calving interval (CI) was performed using the Statistical Analysis System (SAS) version 9.3 (TS1M2) Enterprise Guide 5.1. [22]. For the actual computation a linear model with fixed effects was used:

$$y_{ijklm} = \mu + HYS_i + b_j + c_k + e_{ijkl}$$

, where: μ = mean value, HYS_i = effect of herd, year and season of calving (1 - 4 057), b_j = sire (1 - 618), c_k = effect of bull (1 - 663), e_{ijkl} = residual error.

3. Results and discussion

The basic traits of reproduction traits (DFS, DO, NIC, CI) in dairy cows Slovak Simmental cattle were 78.82 ± 56.86 days, 121.73 ± 85.82 days, 2.14 ± 1.58 times and 407.67 ± 91.33 days. In table 1 are presented results in selected breeding herd Slovak Simmental dairy cows.

Table 1. Statistical characteristic of reproduction traits in dairy cows Slovak Simmental cattle

Traits	n[1]	$\overline{x}$ [2]	SD[3]	CV[4]	MODE[5]
days to first service (DFS)	3 463	78.82	56.86	74.14	62
days open (DO)		121.73	85.82	70.51	67
calving interval (CI)		407.67	91.33	22.40	348
number of inseminations per conception (NIC)		2.14	1.58	73.89	1

[1]Number of observations, [2]Average, [3]Standard deviation, [4]Coefficient of variation, [5]Mode (value that appears most often in a set of data)

Figure 1 shows the differences for reproduction traits by years 2012 to 2016 in selected breeding herds of Slovak Simmental dairy cows. The values of reproduction traits were between 67.69 ± 21.6 to 88.36.10 ± 75.22 days for DFS, 103.92± 69.3 to 134.7 ± 107.9 days for DO, 1.82± 1.25 to 2.26 ± 1.6 times for NIC and 397.92± 76.27 to 422.1± 11.89 days for CI in dairy cows of Slovak Simmental cattle. This tendency is lower.

These results are similar with conclusions Riecka *et al.* [11], where average values reproduction traits has fluctuating tendency.

The results of reproduction traits by breeding type divided into 3 groups are presented in Table 2.

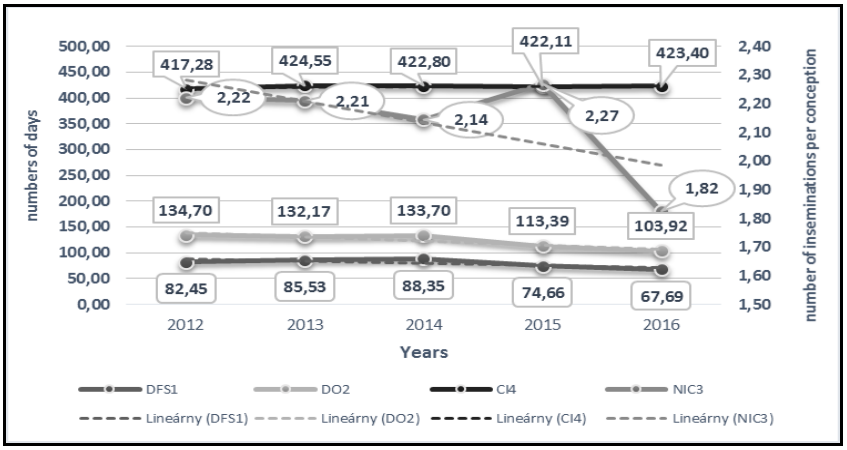

Figure 1. Reproduction traits by years 2012 to 2016 in Slovak Simmental dairy cows

Table 2. Statistical characteristic of reproduction traits in dairy cows Slovak Simmental cattle by breed-type

Breeding type	Traits	n[1]	$\bar{x}$ [2]	SD[3]	CV[4]	MODE[5]
S_0	DFS[6]	2 614	78.55	55.48	70.63	62
	DO[7]		120.83	84.01	69.53	65
	CI[8]		407.02	90.49	22.23	348
	NIC[9]		2.14	1.61	75.13	1
S_1	DFS[6]	481	78.62	54.00	68.68	62
	DO[7]		124.82	89.26	71.51	64
	CI[8]		408.76	97.26	23.79	346
	NIC[9]		2.04	1.39	68.07	1
S_2	DFS[6]	368	80.99	69.04	85.24	62
	DO[7]		124.07	93.73	75.55	67
	CI[8]		410.91	89.41	21.76	365
	NIC[9]		2.21	1.58	71.76	1

[1]Number of observations, [2]Average, [3]Standard deviation, [4]Coefficient of variation, [5]Mode (value that appears most often in a set of data), [6]Days to first service (DFS), [7]Days open (DO), [8] Calving interval (CI), [9] Number of inseminations per conception (NIC)

Correlation between evaluated reproduction traits were lower positive and statistically high significant, scilicet between days to first service (DFS) and days open (DO), numbers of inseminations per conception (NIC), calving interval (CI) was r= 0.45333, r= -0.10504, r= 0.10577 (Table 3). These results are similar with conclusions Ríos-Utrera et al. [18], Andersen-Ranberg et al. [19] and Sewalem et al. [20]. By reported Ríos-Utrera et al. [18] shows to genetic correlation between reproductions traits (DFS-DO, DFS-NSC, DFS-CI, DO-NSC and DO-CI) were positive.

Table 3. Relation between evaluations of reproduction traits

Traits	DFS[1]	DO[2]	NIC[3]
DO[2]	**0.45333**$^{+++}$	-	-
NIC[3]	-0.10504^{+++}	0.26255^{+++}	-
CI[4]	0.10577^{+++}	0.35271^{+++}	0.02436^{+++}

[1]Days to first service (DFS), [2]Days open (DO), [3] Numbers of inseminations per conception (NIC), [4]Calving interval (CI), $^{+++}$P<0.001

In Table 4 showed the linear model to represent coefficients of determination on days to first service (DFS), days open (DO), number of inseminations per conception (NIC), calving interval (CI) by sources of variability, where the high effects was HYS, than sire for all reproduction traits. These effects were statistical significant (P<.0001). These results are similar with results Dochi et al. [10], Riecka et al. [11] and Pozveh et al. [17] where authors shows the highest effect of HYS (herds-years-season).

Table 4. Factors affecting on reproduction traits in Slovak Simmental dairy cows

Sources of variability	DF[1]	R-Square [2]			
		DFS[3]	DO[4]	NIC[5]	CI[6]
Herd-Years-Season	547	0.294926^{+++}	0.262955^{+++}	0.364690^{+++}	0.257744^{+++}
Sire	178	0.085768^{+++}	0.093665^{+++}	0.096390^{+++}	0.086989^{+++}
Effect of bull	106	0.169196^{+++}	0.095970^{+++}	0.102655^{+++}	0.102330^{+++}

[1]Grades of freedom, [2] Coefficient of determination (R^2), [3]Days to first service (DFS), [4]Days open (DO), [5] Number of inseminations per conception (NIC), [6] Calving interval (CI),
$^{+++}$P<0.001

In Table 5 is showed the linear model to represent coefficients of determination on reproduction traits with all fixed effects R^2 = 0.446556 % for DFS, R^2 = 0.374924 % for DO, R^2 = 0.363125 % for NIC and R^2 = 0.324466 % for CI. These effects were significant (P<.0001).

Table 5. Linear models for all factors on reproduction traits by breeding type in Slovak Simmental dairy cows

Breeding type	Source	Mean Square	F Value	R-Square[2]	Coeff Var	Root MSE	Mean
S_0	DFS[3]	4799.444	2.09^{+++}	0.488075	60.97217	47.89604	78.55394
	DO[4]	10645.85	1.96^{+++}	0.472226	60.94292	73.63485	120.8259
	CI[5]	10271.84	1.42^{+++}	0.392739	20.90211	85.07550	407.0187
	NIC[6]	4.631894	2.78^{+++}	0.559005	60.19218	1.290425	2.143841
S_1	DFS[3]	3359.419	3.00^{+++}	0.424027	42.55340	33.45706	78.62370
	DO[4]	8801.296	1.92^{+++}	0.385957	54.28604	67.75936	124.8191
	CI[5]	9788.587	1.20^{-}	0.329936	22.05707	90.15976	408.7568
	NIC[6]	2.0618634	1.51^{+++}	0.359736	57.30694	1.167584	2.037422
S_2	DFS[3]	5931.575	5.84^{+++}	0.449514	39.33415	31.85959	80.99728
	DO[4]	9777.119	1.75^{+++}	0.349015	60.29537	74.80559	124.0652
	CI[5]	8747.543	1.57^{+++}	0.334797	18.16533	74.64172	410.9022
	NIC[6]	2.6972674	1.50^{++}	0.328368	60.85503	1.341126	2.203804

[1]Grades of freedom, [2] Coefficient of determination (R^2), [3]Days to first service (DFS), [4]Days open (DO), [5]Calving interval (CI), [6]Number of inseminations per conception (NIC)
$^{+++}$P<0.001, $^{++}$P<0.01, $^{-}$P>0.05

4. Conclusions

The basic traits of reproduction traits (DFS, DO, NIC, CI) in dairy cows Slovak Simmental cattle were 78.82 ± 56.86 days, 121.73 ± 85.82 days, 2.14 ± 1.58 times and 407.67 ± 91.33 days.

Correlation between evaluated reproduction traits were lower positive and statistically high significant, scilicet between days to first service (DFS) and days open (DO), numbers of inseminations per conception (NIC), calving interval (CI) was r= 0.45333, r= -0.10504, r= 0.10577. These results were statistical high significant (P<.0001).

The analyses by the effects on reproduction traits were the highest effect of herd-years-seasons (HYS) between R^2 = 0.257744 (CI) to R^2 = 0.364690 (NIC). These results were statistical high significant (P<.0001).

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References

1. Cassandro, M., Genetic aspects of fertility traits in dairy cattle–review. Acta agraria kaposváriensis, 2014, 18.suppl 1: 11-23
2. Berglund, B. Genetic improvement of dairy cow reproductive performance. Reproduction in domestic animals, 2008, 43.s2: 89-95
3. Royal, M.D., Darwash, A. O., Flint, P.F., Webb, R., Woolliams, J. A., Lamming, G. E., Declining fertility in dairy cattle: changes in traditional and endocrine parameters of fertility. J. Anim. Sci., Vol. 70 (3), 2000, p. 487-501
4. Pryce, J. E., Royal, M. D., Garnsworthy, P. C., Mao, I. L., Fertility in the high-producing dairy cow. Livest. Prod. Sci., 86, 2004, p. 125-135
5. M'hamdi, N., Aloulou, R., Brar, S.K., Bouallegue, M., Ben Hamouda, M., Phenotypic and genetic parameters of reproductive traits in Tunisian Holstein cows. Biotechnology in Animal Husbandry, 2010, 26(5-6), 297-307
6. Pantelic, V., Sretenović, L., Ostojić-Andrić, D., Heritability and genetic correlation of production and reproduction traits of Simmental cows. African Journal of Biotechnology, 2011, 10:7117-7121
7. Gredler, B., Fürst, C., Sölkner, J.: Analysis of new fertility traits for the joint genetic evaluation in Austria and Germany. Interbull Bulletin 37, 2007, p. 152-155
8. Ulutaş, Z., Sezer, M., Genetic study of milk production and reproduction traits of local born Simmental cattle in Turkey. Ziraat Fakültesi Dergisi, 2009, 26.1: 53-59
9. Rahbar, R., Aminafshar, M., Abdullahpour, R., Chamani, M., Genetic analysis of fertility traits of Holstein dairy cattle in warm and temperate climate. Acta Scientiarum. Animal Sciences, 2016, 38(3), 333-340
10. Dochi, O., Kabeya, S, Koyama, H., Factors affecting reproductive performance in high milk-producing Holstein cows. Journal of Reproduction and Development, 2010, 56.S: S61-S65
11. Riecka, Z., Candrák, J., Strapáková, E., Factors Affecting Holstein Cattle Fertility Traits in the Slovak Republic. Lucrari stiintifice Zootehnie si Biotehnologii, Scientifical papers Faculty of Animal Sciences and Biotechnologies, Timisoara, 43 (2), 2010, p. 263-267
12.Bujko, J., Candrák, J., Strapák, P., Žitný J., Hrnčár, C., The Assessment of Genetic Diversity and Analysis Production and Reproduction traits in difference breeding type of Slovak Simmental cattle. Scientific Papers Animal Science and Biotechnologies, 2013, 46.2: 58-62
13. Bujko, J., Optimalization Genetic Improvement Milk Production in Population Slovak Spotted Breed. Monograph. Nitra: SPU, 2011, 78 p. (in Slovak).
14. Bujko, J., Žitný J., Hrnčár, C., Factors effecting on the calving interval in Population of Slovak Spotted Breed. In: Book of Abstracts of the XXIVth GENETIC DAYS 2010, Mendel University in Brno, 2010, p. 14, ISBN 978-80-7375-423-5.
15. Kasarda R., Trakovická A., Moravčíková N., Šidlová V., Kadlečík O., Research on Diversity, Utilization and Production Quality of Local Breeds in Slovakia. In PoljoPrivreda, 21(1 SUPPLEMENT): 11-15
16. Gábor M., Trakovická A., Miluchová M., Polymorphisms of bovine calpastatin gene (CAST) in Slovak Spotted breed. In: Potravinárstvo, 2011, 5 (Special edition): 10-13
17. Pozveh, S. T., Shadparvar, A. A., Shahrbabak, M. M., Taromsari, M. D., Genetic analysis of reproduction traits and their relationship with conformation traits in Holstein cows. Livestock Science, 2009, Vol. 125(1), 84-87
18. Ríos-Utrera, Á., Calderón-Robles, R. C., Rosete-Fernández, J. V., Lagunes-Lagunes, J.: Genetic and phenotypic correlations among reproductive traits of dairy cows. Mesoamerican Agronomy, 2010, 21(2), 235-244
19. Andersen-Ranberg, I.M., Klemetsdal, G., Heringstad, B., Steine, T., Heritabilities, genetic correlations and genetic change for female fertility and protein yield in Norwegian dairy cattle, J. Dairy Science, 2005, vol. 88, p. 348-355
20. Sewalem, A., Kistemaker, G., Including Production in Female Fertility Evaluations. In: Interbull Bulletin, no. 38, 2008, p. 44-47
21. The Breeding Service of the Slovak Republic. S.E. Results of dairy herd reproduction recording in Slovak Republic at control years 2012 to 2016
22. SAS Institute Inc: SAS/STAT Software. (2011) Cary NC: SAS Institute Inc: Version 9.3. (TS1M3).