THE RELATIONSHIP BETWEEN THE LENGTH OF PRODUCTIVE LIFE AND THE BODY CONFORMATION TRAITS IN COWS

VZŤAH UKAZOVATEĽOV EXTERIÉRU K DĹŽKE PRODUKČNÉHO VEKU KRÁV

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Abstract

The aim of this study was to analyze the length of productive life in 118 646 dairy cows of the Slovak Simmental breed. The average length of productive life reached 1451 days (3.98 years). The recorded factors with most important impact to the length of productive life were: milk production at first lactation (F = 7736.88+++), year of culling (F = 4890.54) and the age at first calving (F = 2759.81). The length of productive life was significantly affected by reason of culling (F = 272.43) and the Sire (F = 53.43). The analysis of effects of exterior traits to the length of productive life was done in group of 6585 culled cows. From the main exterior traits the most important impact was recorded for body frame (F = 17.39+++), udder (F = 9.43+++) and feet and legs (F = 6.41+++). For more detail advisement was tested the influence of partial exterior traits. From the partial exterior traits the most significant effect to length of productive live had udder depth (F = 26.04+++), teats length (F = 18.49+++), teats thickness (F = 3.23+++) and teats placement (F = 3.31++). From partial traits of feet and legs the most significant effect to length of productive live had heel joint expression (F = 9.10+++) and foot (F = 5.47+++). Results from the present study confirmed the important influence of main and partial exterior type traits of Slovak Simmental breed on the productive life of cows.

Keywords: longevity, length of productive life, effects, type traits, Slovak Simmental breed

Abstrakt

V práci sme hodnotili úroveň dosahovaného produkčného veku 118 646 kráv slovenského strakatého plemena. Priemerný produkčný vek za celý sledovaný súbor predstavoval 1451 dní (3,98 roka). Na dĺžku produkčného veku kráv z definovaných faktorov najvýznamnejšie vplývali produkcia mlieka na prvej laktácii (F = 7736,88+++), rok vyradenia (F = 4890,54) a vek pri prvom otelení (F = 2759,81). Na produkčný vek kráv významne vplývali aj dôvod vyradenia a plemenný býk

(F = 53,43). V populácii 6 585 vyradených kráv slovenského strakatého plemena sme analyzovali vplyv ukazovateľov exteriéru na dĺžku produkčného veku kráv. Z hlavných znakov exteriéru najvýznamnejšie vplývali na dĺžku produkčného veku kráv rámec tela (F = 17,39+++), vemeno (F=9,43+++) a končatiny (F=6,41+++). Pre detailnejšie posúdenie sme testovali úroveň vplyvu jednotlivých čiastkových znakov exteriéru. Z čiastkových znakov vemena najvýznamnejšie ovplyvňovali dĺžku produkčného veku kráv hĺbka vemena (F = 26,04+++), dĺžka ceckov (F = 18,49+++), hrúbka ceckov (F = 3,23+++) a postavenie ceckov (F = 3,31++). Z čiastkových znakov končatín najvýznamnejšie vplývali na dĺžku produkčného veku kráv slovenského strakatého vyjadrenie pätového kĺbu (F = 9,10+++) a paznecht (F = 5,47+++). Výsledky práce potvrdili významný vplyv hlavných a čiastkových znakov exteriéru kráv strakatého plemena na dĺžku produkčného veku kráv.

Kľúčové slová: dlhovekosť, produkčný vek, nepriame úžitkové vlastnosti, exteriér, slovenské strakaté plemeno

Detailed abstract

V práci sme hodnotili úroveň dosahovaného produkčného veku 118 646 kráv populácie slovenského strakatého plemena. Priemerný produkčný vek za celý sledovaný súbor predstavoval 1451 dní (3,98 roka), čo by pri vyhovujúcich ukazovateľoch reprodukcie zodpovedalo priemernému využívaniu dojníc strakatého plemena na úrovni približne 3,4 až 3,6 laktácie.

Okrem toho sme na základe lineárneho modelu s definovanými pevnými efektmi testovali mieru vplyvu jednotlivých faktorov na dĺžku produkčného veku kráv. Na základe vykonanej analýzy sme zistili, že všetky z uvedených faktorov signifikantne ovplyvnili dĺžku produkčného veku. Miera vplyvu jednotlivých faktorov v danom súbore však bola rozdielna. Na dĺžku produkčného veku kráv z definovaných faktorov najvýznamnejšie vplývali produkcia mlieka na prvej laktácii (F = 7736,88+++), rok vyradenia (F = 4890,54) a vek pri prvom otelení (F = 2759,81). Na produkčný vek kráv významne vplývali aj dôvod vyradenia a plemenný býk (F = 53,43) otec kravy, čo potvrdilo opodstatnenosť šľachtenia na dlhovekosť, resp. využívanie plemenných hodnôt dĺžky produkčného veku v selekčných indexoch hovädzieho dobytka.

V populácii 6 585 vyradených kráv slovenského strakatého plemena sme analyzovali vplyv ukazovateľov exteriéru na dĺžku produkčného veku kráv. Z hlavných znakov exteriéru najvýznamnejšie vplývali na dĺžku produkčného veku kráv Rámec tela (F = 17,39+++). Z viacerých odborných prác z oblasti chovu simentalizovaných plemien je známe, že vyššieho produkčného veku z hľadiska veľkosti tela sa dožívajú priemerné kravy, resp. kravy menšieho telesného rámca. Tieto výsledky sa však potvrdili predovšetkým v Nemecku a v Rakúsku, ktoré sa vzhľadom k veľkosti rámca tela odlišujú od populácie slovenského strakatého plemena. Významne a signifikantne vplývali na dĺžku produkčného veku aj vemeno (F=9,43+++) a utváranie končatín (F=6,41+++).

Pre detailnejšie posúdenie vplyvov na dĺžku produkčného veku sme testovali úroveň vplyvu jednotlivých čiastkových znakov exteriéru na dĺžku produkčného veku. Z telových mier, charakterizujúcich vzťahy k veľkosti tela, ako aj k hĺbke, šírke a dĺžke tela sa ako najvýznamnejší znak prejavila dĺžka panvy (F = 6,72+++), hĺbka tela (F = 6,63+++) a obvod hrudníka (F = 5,60+++). Z uvedeného môžeme konštatovať, že širšie, hlbšie a dlhšie kravy s primeranou výškou sa dožívajú v stádach vyššieho produkčného veku. Z analyzovaných čiastkových znakov končatín sme zistili najvýznamnejší vplyv pri ukazovateľoch vyjadrenie pätového kĺbu (F = 9,10+++), a utváranie paznechtu (F = 5,47+++). Výsledky našej práce potvrdili závery viacerých zahraničných a domácich autorov, ktorí zistili jednoznačne pozitívne vzťahy medzi utváraním končatín a dlhovekosťou bez ohľadu na hodnotené plemeno kráv. Pri analýze čiastkových znakov vemena najvýznamnejšie ovplyvnili dĺžku produkčného veku kráv hĺbka vemena (F = 26,04+++) a upnutie zadných štvrtiek (F = 2,16+++).

Z hodnotených znakov ceckov sme vypočítali najvýznamnejší a signifikantný vplyv dĺžky ceckov (F = 18,49+++). Na dlhovekosť kráv vplývali aj hrúbka ceckov (F = 3,23+++) a postavenie ceckov (F = 3,31+++). Na základe vykonanej korelačnej analýzy môžeme konštatovať, že kravy s plytším, dobre upnutým vemenom, so široko rozloženými a ďaleko dozadu siahajúcimi zadnými štvrťkami a strednou dĺžkou a hrúbkou ceckov sa dožívajú v stádach vyššieho produkčného veku.

Introduction

The important role in the dairy breeding improving plays not only production and reproduction traits but also the time during which the cows provide the adequate profit, which is matching the longevity [25]. The economic value of the dairy cows is in most size given by its milk yield and longevity. With increasing longevity and lifetime milk yield total income is increasing [29].

In the literature sources longevity is evaluated by a wide scale of indicators. Most common are number of calvings, number of lactations, stayability, length of productive life, average age of herd etc.

Various methods of longevity evaluation described [39] observe and compare miscellaneous ways of longevity evaluation in particular breeding countries: length of herd life – period between birth and culling, length of productive life – period between first calving and culling, total milk production – lifetime milk yield, number of days of lactation, number of lactations.

The length of productive life in animals is expressed as raw production time, or as a period from first calving to culling of cow from a herd. The length of productive life, in this meaning is the “real production lifetime”, independent on production. In case of correction to milk yield in cow, also so-called “functional length of productive life” is described, which is declared as the cow’s ability to delay involuntary culling because of illness or sterility.

Direct selection to longevity is impractical because of low heritability jointed with relatively long generational interval [27] as well as the low efficiency of direct selection to longevity [34]. Therefore the new ways of breeding and optimal traits of longevity in cattle are still requested.

One of the possibilities of longevity estimation is application of correlated traits, which shows the survival ability in young age. There is the conformation traits involved in it: body, feet and legs, and udder conformation [11].

Another possibility is the use of high phenotypic and genetic correlations between first lactation milk yield and longevity traits. Several authors suggested the phenotype correlation from 0.2 to 0.4 and genetic correlation from 0.2 to 0.6 [10, 36].

Decrease in length of productive life for cows of particular breeds in Austria, except the Tyrol Grey breed was found [13]. The Fleckvieh breed reached the level 3.56 year of age in 2004 year, the Holstein breed reached 3.21 year of age and Pinzgau reached 3.53 year of age. Author suggests more strict selection at farms as reason for this tendency, because the genetic trends of longevity are relatively fixed.

The effect of internal and external factors to longevity in group of 1546 cows of the Holstein breed was analyzed. Culling was mostly affected by number and stage of lactation. The highest risk of culling was recorded at first lactation and decreased with increasing number of lactations. The next important trait was milk yield as higher milk yield means lower risk of culling. The sire (fertility) and kin (kinship) effect was considerable, but the suitable number of culled daughters is requested to be analyzed. Other factors have not sensible effect to longevity [20].

The considerable effect of farm on longevity was confirmed [31, 32]. The relevant differences between herds were previously mentioned by [22, 17].

The effect of the body size to production lifetime in the Holstein breed was recorded [15]. The group of dairy cattle with smaller body frame reached higher longevity than group of the dairy cattle with larger body at 72 months and 84 months of age.

Relationship between longevity and the type traits in the Czech Simmental Cattle was also observed [41]. The lowest age at culling reached dams with values from 1 to 4 points in traits as body and udder conformation and an increasing point levels were also related to increasing age at culling. The length of teats and body capacity had opposite tendency.

The relation of longevity to type traits in the Fleckvieh breed in Bavaria was analyzed and found that cows with defects in legs conformation – hocks, heel joint expression, fetlock and claws reached worse results not only in milk yield, but also in length of productive life [23]. It was mentioned that next genetic correlation among longevity (direct herd life) and recorded type traits of legs - claws balance (r = 0.85), high of claw (r = 0.44), rear legs set (r = 0.67) and bone quality (r = 0.45) [5].

A large number of data on first lactations and classification of type (896529 records) in the Holstein cows born from 1977 to 1991 were analyzed by [16]. The high genetic correlation was found between functional longevity and total score (r = 0.59), body frame (r = 0.20), rump angle (r = 0.19), feet and legs (r = 0.23), fore udder (r = 0.56), rear udder (r = 0.49), udder (r = 0.57) and dairy character (r = 0.06).

A positive genetic correlations between functional longevity and udder depth (r_g = 0.43), rear teats placement (r_g = 0.21) and fore udder attachment (r_g = 0.15) were found [9]. Negative correlations were found between exterior traits for teats length (r_g = -0.42), rear legs set (r_g = -0.29) and body stature (r_g = -0.13). Additional traits which affect production lifetime are body conformation traits recorded during type classification, mainly feet and legs and udder conformation.

The highest positive correlation between longevity and udder traits (udder attachment r = 0.47, udder depth r = 0.38) among recorded traits was detected [6]. Similar results were previously mentioned [8] and suggested udder conformation as most important feature affecting longevity, especially fore udder attachment and udder depth. In addition, cows with correct rear legs set and cows with steep foot angle reached higher length of productive life under all housing conditions. The same conclusions were suggested also by other authors [12], [14], and [5]. Feet and legs conformation has considerable relationship to functional length of productive life (r ranged from 0.62 to 0.69) [14].

Correlations of particular udder traits and functional length of productive life from r = 0.1 (udder cleanness evaluated by nonlinear method) to r = 0.19 (suspensory ligament and teats conformation) were observed [30].

In Brown Swiss breed the highest genetic correlations were calculated between longevity, udder, and teats evaluation (r from 0.38 to 0.66). Low to medium values were calculated for rear legs set (r = 0.35), feet (r = 0.25), fetlock (r = 0.21), body length (r = 0.39), and body depth (r = 0.42) [39].

The aim of this study was to asses the effects affecting length of productive life and relations between conformation traits and length of productive life in the Slovak Simmental breed population.

Materials and methods

The starting point for analysis of the length of productive life evaluation were records of 118 646 culled cows from database of Breeding Services of Slovak Republic and Slovak Simmental Cattle Herd Book from 1997 to 2005. The length of productive life was defined as a period from the first calving to culling from a herd. It was calculated for each individual dairy cow. Effects which were considered to affect the length of productive life, such as milk production in first lactation, year of culling (as quantitative variables), age at first calving, farm, reason of culling, breeding group (S_0, S_1, S_2) and sire (as classification variables) were selected on the basis of

information from literature. Breeding groups were defined according to the methodology of Herdbook of Slovak Simmental breed, i.e. S_0 (up to 12,5 % of genotype belonging to other breeds), S_1 (from 12,6 % to 25 % of genotype belonging to other breeds) and S_2 (from 25,1 % up to 50 % of genotype belonging to other breeds).

The effect of impact to length of productive life was calculated by simple linear model (GLM procedure)

$$Y_{ijkl} = \mu + Po_i + Pl_j + O_k + Dv_l + Rv_m + b1(mlieko)_{ijklm} + b2(vek)_{ijklm} + e_{ijklm}.$$

Y_{ijklm} - length of productive life

μ - mean

Po_i - effect of i – farm

Pl_j - effect of j – breeding group

O_k - effect of k – sire

Dv_m - effect of l – reason of culling

Rv_n - effect of m – year of culling

$b1(mlieko)_{ijklm}$ - linear regression of milk production in first lactation

$b2(vek)_{ijklm}$ - linear regression on age at first calving

e_{ijklm} - residual error

For greater reliability of model, we used only culled cows of Slovak Simmental breed.

Since October the 1st 1997, the “System 97” – Integrated European system for type classification in the Simmental cattle is used for type classification in Slovakia.

The relations between conformation traits and length of productive life were evaluated in group of 6 585 cows, for which official records of type classification were obtained. The precise estimation of interaction between effects was done by linear models. Impact of main and partial traits and groups of traits of conformation to length of productive life were tested.

For main type traits of impact to length of productive life was calculated by simple linear model (GLM procedure)

$Y_{ijklm} = \mu + RT_i + O_j + K_k + V_l + CV_m + e_{ijklmn}$

Y_{ijklmn} - lenght of productive life

μ - mean

RT_i - effect of i - body frame

O_j - effect of j - muscularity

K_k - effect of k - feet and legs

V_l - effect of l - udder

CV_m - effect of m - udder cleanness

e_{ijklmn} - residual error

Similar linear models were used for evaluation of partial exterior type traits on length of productive life. Statistical analysis in relation to each parameter was calculated using PC statistical program SAS version 9.02.

Results and discussion

The length of productive life describes net production period in days as time period from the first calving to culling from herd. The level of reached real length of productive life in population of 118 646 cows of the Slovak Simmental breed cattle is reported. The average length of productive life was 1451 days, what under condition of suitable reproduction represents average usage at level 3.98 lactations in dairy cows. The considerable lower levels of length of productive life (for 376 days of productive life) were found for population of the Czech Fleckvieh breed [25].

The precise estimation of impact of particular traits to length of productive life was done by simple linear model. The analysis shows that all the investigated factors considerably affect the length of productive life. The degree of the effect was various (Table 1). In both breeds the most important factor was the milk production in first lactation (F = 7736.88+++). The positive correlations between the first lactation milk production or breeding values for milk traits and the length of the productive life of cows in different populations were also reported by [1], [10], [25], [27], [33] and many others. The length of productive life was significantly affected by year of culling (F = 4890.54), the age at first calving (F = 2759.81) and reason of culling (F = 272.43). The effect of the year of culling (year of birth) on productive life may be caused by general increase in intensity and efficiency of milk production, by increase in variability of the herd, by decrease in dairy cow care.

The length of productive life was considerably affected by the farm, the farm management (F = 26.32+++) and the sire (F = 53.43), father of cow. The latest confirms the justness of the selection to longevity, i.e. including the breeding values for longevity into breeding programmes.

The results of present study are in agreement with the study of [20] who found out considerable effect of the sire and the age at first calving. Also the importance of farm effects and considerable differences between herds were reported by many authors [17, 22, 31, 32].

Table 1: The tests of factors affecting the length of productive life in the cows of Slovak Simmental breed.
Tabuľka 1: Testovanie vplyvu faktorov na dĺžku produkčného života kráv slovenského strakatého plemena

Effect[1]	d. f.[2]	Mean Square[3]	F Value[4]
Milk yield at first lactation[5]	1	1429393661	7736,88+++
Year of culling[6]	8	903530047	4890,54+++
Age at first calving[7]	1	509876840	2759,81+++
Farm[8]	1734	4862928	26,32+++
Reason of culling[9]	12	50331807	272,43+++
Breeding group[10]	3	3342002	18,09+++
Sire[11]	2838	9871201	53,43+++
Residual error[12]	109428	0,336254	

[1]Efekt, [2]Stupne voľnosti, [3]Suma štvorcov, [4]F-hodnota, [5]Produkcia mlieka na prvej laktácii, [6]Rok vyradenia, [7]Vek pri prvom otelení, [8]Podnik, [9]Dôvod vyradenia, [10]Plemenná skupina, [11]Býk, [12]Reziduálny chyba

Relation between length of productive life and conformation traits

One of view points of indirect selection on longevity is application of the correlated traits, which are particularly important in early life of an animal. From the group of main and partial traits are the most important body conformation traits, such as feet and legs and the udder conformation [10].

The analysis of the investigated group (6585 cows) shows considerable effect of main trait – the body frame (F = 17.39+++) to the length of productive life (Table 2).

Correlation analysis (Table 3) confirmed that the cows with average body frame has longer productive life, than cows with smaller body frame (r = -0,093). Several authors [13, 23, 30] mentioned that higher longevity in the Simmental breed cows is related to the average or small body size. Such results were confirmed mainly in

Table 2: The effect of main and partial traits of type classification to length of productive life in cows
Tabuľka 2: Vplyv hlavných a čiastkových znakov exteriéru na dĺžku produkčného veku kráv

Effect[1]	d. f.[2]	Mean Square[3]	F Value[4]	Significance[5]
Main type traits[6]				
Body frame[7]	9	8688033,96	17,39	+++
Muscularity[8]	9	1029225,83	5,87	+++
Feet&Legs[9]	8	3201928,90	6,41	+++
Udder[10]	9	4710680,30	9,43	+++
Udder cleanness[11]	9	1211201,00	2,42	+
Partial type traits[12]				
Croup height[13]	8	977525,0	5,66	+++
Rump width[14]	8	142826,31	0,83	-
Rump lenght[15]	8	1159630,94	6,72	+++
Body depth[16]	7	1144225,23	6,63	+++
Body lenght[17]	8	683317,72	3,96	+++
Chest circumference[18]	8	966474,13	5,60	+++
Muscularity[19]	9	1029225,83	5,87	+++
Rump slope[20]	6	2292766,27	13,29	+++
Rear legs set[21]	6	325269,32	1,88	++
Heel joint expression[22]	6	1607218,32	9,10	+++
Fetlock[23]	6	289147,02	1,68	+
Foot[24]	6	94425,31	5,47	+++
Fore udder[25]	6	162212,19	0,94	-
Rear udder[26]	7	360234,58	2,09	+++
Rear udder attach-ment[27]	6	373336,65	2,16	+++
Suspensory ligament[28]	7	170979,39	0,99	+
Udder depth[29]	7	4493443,11	26,04	+++
Teats lenght[30]	5	3191003,5	18,49	+++
Teats thickness[31]	5	557101,24	3,23	+++
Teats arrangement[32]	6	472486,36	2,74	+
Teats placement[33]	5	571428,88	3,31	++
Residual error[34]	0,581676			

[1]Hodnotené znaky, [2]Supne voľnosti, [3]Suma štvorcov, [4]F-hodnota, [5]Preukaznosť, [6]Hlavné znaky exteriéru, [7]Rámec tela, [8]Osvalenie, [9]Končatiny, [10]Vemeno, [11]Čistota vemena, [12]Čiastkové znaky exteriéru, [13]Výška na kohútiku, [14]Šírka panvy, [15]Dĺžka panvy, [16]Hĺbka tela, [17]Dĺžka tela, [18]Obvod hrudníka, [19]Osvalenie, [20]Sklon zadku, [21]Postoj zadných končatín, [22]Pätový kĺb-vyjadrenie, [23]Sponka, [24]Paznecht, , [25]Predné štvrťky, [26]Zadné štvrťky, [27]Upnutie zadných štvrtiek, [28]Závesný väz, [29]Hĺbka vemena, [30]Dĺžka ceckov, [31]Hrúbka ceckov, [32]Rozmiestnenie ceckov, [33]Postavenie ceckov, [34]Reziduálna chyba

Table 3: Main and partial type traits relation to the lenght of productive life in cows of Slovak Simmental breed
Tabuľka 3 Vzťah hlavných a čiastkových znakov exteriéru k dĺžke produkčného veku kráv slovenského strakatého plemena (n = 6585)

Traits[1]	2	s3	r4	t5
Main type traits[6]				
Body frame[7]	6,400	1,337	-0,093	+++
Muscularity[8]	5,629	1,164	0,069	+++
Feet&Legs[9]	5,970	1,034	-0,098	+++
Udder[10]	5,608	0,994	0,060	++
Udder cleanness[11]	8,442	1,132	-0,033	+++
Partial type traits[12]				
Croup height[13]	7,060	1,854	-0,131	+++
Rump width[14]	4,891	1,616	0,161	+++
Rump lenght[15]	5,186	1,460	0,161	+++
Body depth[16]	6,565	1,204	0,234	+++
Body lenght[17]	5,095	1,491	0,117	+++
Chest circumference[18]	5,740	2,316	0,126	+++
Muscularity[19]	5,625	1,169	0,066	+
Rump slope[20]	5,335	0,833	-0,234	+++
Rear legs set[21]	5,017	0,983	0,146	+++
Heel joint expression[22]	6,795	1,142	0,136	+++
Fetlock[23]	4,812	0,949	-0,151	+++
Foot[24]	4,705	1,046	-0,069	++
Fore udder[25]	5,660	1,090	-0,001	-
Rear udder[26]	6,144	0,899	0,262	-
Rear udder attachment[27]	5,472	1,186	0,152	+++
Suspensory ligament[28]	5,708	1,317	0,113	+++
Udder depth[29]	6,666	1,013	-0,376	+++
Teats lenght[30]	5,276	0,804	-0,201	+++
Teats thickness[31]	5,163	0,757	0,156	+++
Teats arrangement[32]	3,868	0,965	-0,081	++
Teats placement[33]	4,406	0,702	-0,041	-

[1]Hodnotené znaky, [2]Priemer, [3]Smerodajná odchýlka, [4]Korelačný koeficient, [5]Preukaznosť, [6]Hlavné znaky exteriéru, [7]Rámec tela, [8]Osvalenie, [9]Končatiny, [10]Vemeno, [11]Čistota vemena, [12]Čiastkové znaky exteriéru, [13]Croup height, [14]Šírka panvy, [15]Dĺžka panvy, [16]Hĺbka tela, [17]Dĺžka tela, [18]Obvod hrudníka, [19]Osvalenie, [20]Sklon zadku, [21]Postoj zadných končatín, [22]Pätový kĺb-vyjadrenie, [23]Sponka, [24]Paznecht, , [25]Predné štvrťky, [26]Zadné štvrťky, [27]Upnutie zadných štvrtiek, [28]Závesný väz, [29]Hĺbka vemena, [30]Dĺžka ceckov, [31]Hrúbka ceckov, [32]Rozmiestnenie ceckov, [33]Postavenie ceckov

German and Austrian populations, which are different from population of the Slovak Simmental breed [13, 23]. Besides, the cows from present study were culled during the period 1997 - 2005 when the body size of the Slovak Simmental breed population increased for 3 – 5 cm. It can affects the results of evaluation considerably. Considerable effect to the length of productive life was recorded also in the feet and legs conformation (F = 4.18+++), the udder (F = 6.38+++) and muscularity (F = 5.87+++). Because we evaluated all the breeding groups (S_0, S_1, S_2) together (Table 2), the influence of type variability of evaluated cows could be affected in muscularity trait. According to Slovak and international literature, as well as on the basis of practical experiences, the most important main and partial exterior type traits which affect longevity are legs and feet and udder conformation. These observations were confirmed by many authors who evaluated Simmental breeds in Europe [28, 14, 23, 30].

For detailed review the level of effect in the particular traits of the type classification to the length of productive life was tested (Table 2).

From the measures characterizing relation to the body size as well as depth, width, and length of body the most related importance was recorded for the rump length (F = 6.72+++), the body depth (F = 6.63+++) and the croup height and the chest circumference at similar level (F = 5.66+++ and 5.60+++ respectively). From these results and correlation analysis it can be concluded, that cows with longer rump length, deep, medium and small body frame, with a higher body cubage (chest circumference) and longer body, have longer productive life (Table 3). The improvement of measured values of exterior partial traits resulted from a use of imported bulls (from Germany and Austria) during the last ten years. In accordance with our results [16] and [9] suggested the positive relation of body size or height to the longevity. On the other hand, unalterable negative relations between the body size and the longevity were found by [15].

The effect of croup height (significantly affects the final result of the main trait body frame) to production life of cows in the Slovak Simmental breed was recorded (r = -0.131) (Table 3). Based on these results we can also confirm that cows with a smaller or medium body frame, had longer productive life, than cows with bigger body frame.

The impact of body height and body frame to the longevity of cows has been published by several authors [28, 9, 21].

Similar trends in the positive impact of chest circumference and body depth to length of productive life of cows were also found by [24] and [38], respectively [39]. On the other hand, negative impact of body depth on the longevity was detected by [19] and [26]. The analysis of relation of partial traits of feet and legs to length of productive life (Table 2) shows the most important effect of hell join expression (F = 9.105+++), foot (F = 5.47+++) and rear legs set (F = 1.88+++) and total point score of feet and legs (F = 4.18+++). Based on these results, and performed correlation analysis (Table 3) we can say that cows with drier obstructions joint (expresses indirectly

constitution of an animal and his skeleton softness) and correctly structured in foot and fetlock, as well as the desired correct position rear legs set, reach longer productive life. Influence of rear legs set position on the length of productive life was confirmed in [8], [39], [4], [9] and in population of Fleckvieh breed in Bavaria [23], [30], where heel joint expression is considered as very important partial trait in main assessment. In line to our results, significant impact of fetlock and foot to the longevity of cows was found by [39, 30, 23, and 21]. The effect of foot formation to the numbers of completed lactations was calculated and analyzed by [4].

The analysis of partial traits of the udder shows the most important effect of udder depth (F = 26.04+++), rear udder attachment (F = 2.16+++) and rear udder conformation (F = 2.09+++) to the length of productive life (Table 2). The suspensor ligament manifestation also affected the productive life considerably.

The importance of udder depth as a main trait of udder conformation, that affects longevity and length of productive life, was confirmed by [21], [6], [24], [7], and especially by [18] and [9].

The results of our work were in accordance with findings of [35], [3], [30], [16], who calculated the significant relationships of rear udder. Some authors [6, 7] considered the rear udder attachment like one of the major trait of the udder affecting the longevity of cows.

In terms of suspension ligament and fore udder the results of our analysis confirm [18], who found low relationship between longevity and cows suspension ligament or fore udder formation. Contrary with our results [35], [3] and [30] considered suspension ligament as an important exterior trait conducive to the length of productive life of cows. The close relationship between the udder faults and longevity of cows was found [40]. From evaluated teats traits the most important effect to longevity was the teats length (F = 18.49+++). The longevity of cows were affected also by teats thickness (F = 3.23 +++) and placement (F = 3.31 +++) (Table 2). Significant impact of teats formation, especially of the length of teats, and longevity were also found by [24], [7] and [39]. Significant impact of teats placement and teat formation to the longevity was confirmed by [9] and [30]. Our results show that the dairy cows with less shallow, well attached udder, wide and long rear udder and mean teats length reached higher productive life in herds (Table 3).

Conclusion

Results from this study confirmed the important influence of selected factors of Slovak Simmental breed on the productive life of cows. The most important factors affecting longevity were milk production at first lactation, year of culling, age at first calving and breeding bull. High statistical significance of tested factors confirmed the hypothesis of their importance for selection. The important influence of exterior traits – main traits - body frame, legs and udder on length of productive life of cows of Slovak Simmental breed was confirmed. Results from the present study confirmed

the important influence of main and partial exterior type traits of Slovak Simmental breed on the productive life of cows.

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