The influence of health status in calves with subsequent growth of heifers and milk production in dairy cows

Vplyv zdravotného stavu teliat na následný rast jalovíc a produkciu mlieka dojníc

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Abstract

The aim of this study was to analyze the association between enteritis and pneumonia during first months of life and subsequent growth and milk production traits of these animals. A total of 1327 calves were followed in this study. Calves were divided into three groups: Group A) healthy calves; Group B) calves that suffered from the enteritis one or more times from the birth to 6 th month of age; and Group C) calves that suffered from birth to 6th month of age from the pneumonia. Subsequently all animals were observed at the following age stages: calves, heifers and cows. For all groups (age stages) the body weight and daily weight gain in calves (in the breeding period from birth to 6th month of age), the weight and daily weight gain weight in heifers (in the breeding period from 7 th to 25 th month of age) and production parameters of cows in the first lactation (milk in kg, fat in kg and protein in kg) was recorded. Calves in Groups B and C exhibited lower average daily gain (690.40 g, SD = 186.18, N.S. and 636.80 g, SD = 221.19, $P < 0.05$ respectively) than healthy calves (Group A, 703.91 g, SD = 223.48). Heifers in Group B exhibited increased the daily weight gain (830.01, SD = 73.57, N.S.) compared to healthy animals (Group A, 828.31, SD = 89.16). The general hypothesis regarding the negative effect of the enteritis (in breeding age animals that suffer from disease) on growth in the Simmental breed has not been confirmed. Heifers that had suffered with the pneumonia (Group C) showed significantly lower average daily gain (784.64, SD = 102.96, $P < 0.05$) than heifers in group A and B. In the evaluation of milk production in the first lactation, average production of 5800 kg per lactation (SD = 3.96) was recorded in Group A cows. Cows in Group B in the first lactation produced the 5977 kg of milk per lactation on average (SD = 4.31). Cows from Group C in first lactation produced lowest amount of milk during the first lactation period (5674 kg, SD = 3.87), but difference among A, B and C group was not significant.

Key words: health status, calves, average daily gain, milk production traits, diseases

Abstrakt

Cieľom práce bolo analyzovať vplyv hnačkových a respiratórnych ochorení teliat v prvých mesiacoch života na následný rast teliat a jalovíc, ako aj produkciu mlieka dojníc na prvej laktácii. V experimente sme hodnotili celkom 1327 teliat slovenského strakatého plemena, ktoré boli rozdelené do troch skupín: A - zdravé teľatá, B - teľatá ktoré od narodenia do veku 6 mesiacov prekonali jeden alebo viackrát hnačkové ochorenie(enteritídu) a skupinu C predstavovali teľatá ktoré prekonali od narodenia do veku 6 mesiacov respiratórne ochorenie (pneumóniu). Všetky zvieratá boli v priebehu života hodnotené vo vekových kategóriách ako teľatá, jalovice a dojnice. Pri hodnotení zvierat sme podľa vytvorených skupín sledovali živú hmotnosť a priemerné denné prírastky teliat (v období od narodenia do veku 6 mesiacov), živú hmotnosť a priemerný denný prírastok v priebehu odchovu jalovíc (od 7 do 25 mesiacov veku) a ukazovatele mliekovej úžitkovosti dojníc na prvej laktácii (produkcia mlieka v kg, tuku v kg a bielkovín v kg). Teľatá, ktoré od narodenia do veku 6 mesiacov prekonali jeden alebo viackrát hnačkové ochorenie (enteritídu) alebo respiratórne ochorenie (pneumóniu) dosiahli v priebehu odchovu nižší priemerný denný prírastok (690,4 g, s = 186,18, n.s., resp. 636,8 g, s = 221,19, $P < 0,05$) v porovnaní so zdravými teľatami (kontrolná skupina, 703,3 g, s = 223,48). Jalovice, ktoré prekonali hnačkové ochorenie (skupina teliat B) dosiahli porovnateľný, resp. mierne vyšší priemerný denný prírastok v porovnaní so zdravými jalovicami skupiny A (830,01 g, s = 73,57, resp. 828,31 g, s = 89,16, n.s.), čím sa nepotvrdil negatívny vplyv hnačkových ochorení na rast jalovíc simentálskeho plemena v priebehu odchovu. Jalovice ktoré prekonali od narodenia do veku 6 mesiacov pneumóniu (skupina teliat C) dosiahli preukazne nižší priemerný denný prírastok (784,64 g, s = 102.96, $P < 0.05$) v porovnaní so zdravými jalovicami, resp. jalovicami, ktoré prekonali enteritídu (skupiny A a B). Pri hodnotení ukazovateľov mliekovej úžitkovosti dosiahli zdravé dojnice na prvej laktácii (kontrolná skupina teliat A) priemernú produkciu mlieka za laktáciu 5800 kg (s = 3,96). Dojnice, ktoré v priebehu odchovu teliat od narodenia do veku 6 mesiacov prekonali hnačkové ochorenie (skupina B) vyprodukovali na prvej laktácii v priemere 5977 kg mlieka (s = 4,31) a dojnice, ktoré prekonali pneumóniu (skupina teliat C) dosiahli najnižšiu produkciu mlieka (5674 kg, s = 3,87), ale rozdiely medzi hodnotenými skupinami dojníc neboli štatisticky preukazné.

Kľúčové slová: zdravotný stav, teľatá, priemerný denný prírastok, znaky súvisiace s produkciou mlieka, choroby

Introduction

Diseases of the gastrointestinal and respiratory tract are the most important disease of calf with impact on calf breeding efficacy and subsequent production. Diseases have relation to increased death loss but also to indirect costs of medication and body mass loss. Diseases in an early period of life weaken calf fitness and cause developmental reduction that subsequently induces further health problems and decrease amount and quality of the production (Virtala et al., 1996; Kozasa et al., 2005, Laureyns et al., 2009). Calving difficulty can influence the vitality in first period of their life too (Neja, 2013)

Age at first calving in cows is determined by the growth rate of heifers from birth to sexual maturity. Growth rate in heifers also affects milk production. For Red Danish, Black and White Danish (Holstein type), and Jersey, milk production during first lactation was higher for cows that gained about 600 g daily in the pre-pubertal period than for cows that grew either faster or slower (Sejrsen, 2000). In contrary, Foldager and Krohn (1994) failed to demonstrate the significant effect of the very high average daily gain during the first 6 and 8 weeks of life on subsequent milk production.

In relation to diseases, Schmoldt et al. (1979) showed, that the pneumonia alone, the diarrhea alone, and both together decreased body weight daily gain by 1.3, 3.0, and 4.8 g. kg^{-1}, respectively, during 44 to 60 days follow up period in 341 female dairy pre-weaned calves. The corresponding relative decline in growth rate was 8.0, 18.0, and 29 %, respectively. Van Donkersgoed et al. (1993) followed 325 calves from birth to 1.5 and 6 months of age and reported that calves with the pneumonia, either diagnosed and treated by the owner or diagnosed by the semi-monthly clinical examinations by the research veterinarian, exhibited reduced girth growth during the first month of life.

The variation in production is associated probably more with body weight as with age as shown the 180-day production records of 1344 lactations in Holstein cows, including records of lactations one through eight collected from six herds, used to determine the independent effects of age and weight on production (Clark and Touchberry, 1962). The most important sources of genetic variation in gross efficiency are likely the quantities of forage eaten and used for yield or maintenance, and the extent to which body tissue was mobilized. When economic values are derived, energy norms or genetic correlations can be used, and double counting of the feed costs needs to be avoided. An index that contains linear type traits, however, gives high accuracy of selection. Hence, although the great potential to improve economic efficiency by selecting for feed intake and live weight or by possible indicator traits appears, there is still uncertainty about some of the genetic parameters, especially among the traits related to health, reproduction, and energy balance (Veerkamp, 1998; Strapák and Aumann, 1998; Strapák et al., 2005; Vacek et al., 2006).

The purpose of this study was to evaluate the effects of gastrointestinal and respiratory diseases in early developmental stage of life (as calves) on subsequent calf and heifer growth ability and dairy production parameters in Slovak Simmental breed.

Materials and methods

Data from 1327 calves born in a period from 2005 to 2010 in 5 commercial Slovak Simmental dairy herds were evaluated. Retrospective cross-sectional observation study design was used for investigation. Calves were divided into three groups: Group A) healthy animals, which were without any signs of disease (enteritis or pneumonia) from birth till the 6^{th} month of age (n = 863). Group B) calves which suffered from the enteritis once or more times from the birth to the 6^{th} month of age (n = 292). Group C) calves which suffered from the pneumonia during period from birth to 6^{th} month of age (n = 172). Records describing health status of calves in age from 0 to 6 months were obtained from the farm records (Record on Animal Health Status; Registration Card of Animal) and from veterinary service records. The

diseases were diagnosed by the practical veterinarian. Samples for pathogen origin determination (nasal and rectal swabs, cadavers) were analyzed in State Veterinary and Food Institute of Slovak Republic in Nitra. Diseases of the digestive tract resulting in the enteritis were caused mainly by *E. coli var. haemolytica* in calves of age 2 months and *Eimeria spp.* in older calves. Most of the pneumonia cases were caused by *Pasteurella multocida*.

Subsequently, records of all animals were evaluated and analysed in following age stages: calves; heifers; cows. The calves body weight was recorded in one-month period (30 days) from born to 6 months of age for calves of Groups A, B and C. Body weight of heifers was recorded during the period from 7 to 25 months of age in three-months period (at 7, 10, 13, 16, 19, 22 and 25 months of age) (Table 1).

Data about calf and heifer growth parameters were retrieved from the Farm records and from official data of The Breeding Services of Slovak Republic (Performance Recording of Calf and Young Cattle).

The average daily gains were calculated for calves (for period from birth to 6th month of age) and heifers (for period 7 – 25 months of age). Average daily gains in all Groups (A, B, C) were compared. In the same animals (n = 1327) and in the age of >26 months the milk production traits at the first lactation was compared in all groups. Within each group of calves (A, B, C) the descriptive statistics (mean, SD) for growth and milk production traits were calculated.

The records of the first lactation (kg of milk, percentage of fat, kg of fat, percentage of proteins, and kg of proteins) were obtained from The Breeding Service of Slovak Republic (Milk Recording in accordance with ICAR rules, standardized for 305 days lactation length) and from the Farm animal records. We have tested hypotheses that health status will influence the average daily gain and milk production too.

H1: healthy animals (Group A) will have higher average daily gain.

H2: healthy animals (Group A) will have higher milk production.

Differences between groups were tested by Student`s t-test for independent samples.

For evaluation of influence of diseases on body weight was used linear model from GLM procedure (SAS Enterprise Guide 3.0).

$y_{i,j,k,l,m} = \beta a_i + d_j + s_k + hys_l + e_{i,j,k,l}$
where:
$y_{i,j,k,l,m}$ = vector of body weights at different ages
βa_i = linear regression of different age of weighting i
d_j = effect of disease j
s_k = effect of sire k
hys_l = effect of herd-year-season l
$e_{i,j,k,l,m}$ = random residual effect m

Results

Calves from Group B reached the average daily gain 690.4 g what was for 13.51 g less than in Group A (Table 2). The difference is not significant but if consider the whole period, the difference in absolute weight would be 2.5 kg per one animal. Calves which suffered from respiratory diseases (Group C) showed average daily

gain 636.8 g. In comparison with healthy calves (Group A) it is significant lower value (-67.11 g, P <0.05) (Table 2). It means a loss of 12.3 kg of absolute weight per one animal per period for the farm.

A heifer comes from Group B showed slightly higher average daily gain (830.01) than heifers comes from Group A (829.87 g) (Table 3). Difference 1.7 g is not significant, but the hypothesis about negative effect of diarrhea on heifer's growth in Simmental breed has not been confirmed.

The respiratory diseases had different effect on recorded daily gain in Simmental heifers. Heifers after the pneumonia (Group C) reached average daily gain 784.64 g, which is decreasing for 43.7 g in comparison with heifers comes from healthy calves (Group A) (Table 3). The difference is significant (P < 0.05). The economic loss hypothetically could be 24.0 kg in absolute growth per one heifer per period and 3044.8 kg for total number of evaluated 172 animals, which is a relatively big amount.

The milk production in the first lactation in Group A was 5800 kg of milk, the fat and protein content were 4.82 and 3.39 % resp. The milk production in Group B was higher about 177 kg than in Group A (5977 kg), the fat and protein content were 4.94 % and 3.37 % resp. Milk production in Group C was 5674 kg, the fat and protein content were 4.85 % and 3.40 % resp. The milk production in Group A was higher about 129 kg than in group C, but there were no significant differences among the Groups.

Based on linear model the impact of diseases (F = 3.52 ++), sires (F = 5.26 +++), ages (F = 12444.7 +++) and herd-year-season (F = 3.47 +++) on body weight were confirmed. Coefficient of determination was R2 = 0.9468.

Discussion

Growth ability in calves and heifers of the Slovak Simmental breed was evaluated by average daily gain, because decreasing daily gain is the common consequence of diseases in this period of life. Diarrhea often occurs in young calves, during first three months of life (Langovi et al., 2004).

Healthy calves of Slovak Simmental breed reached average daily gain 0.704 kg, what is in accordance with the results of Krupa et al. (2005), with data range 0.703 - 0.750 kg. A similar study was carried out in 845 calves born during 1991 at 30 Holstein dairy farms in southeast Minnesota by Sivula et al., 1996a. Incidence rate for all morbidity, the enteritis, and the pneumonia were 0.20, 0.15, and 0.10 cases per 100 calves for the period of the study. Risk of the enteritis was highest in the first 3 weeks of life; highest risk of the pneumonia was found at 10 weeks of age. Case fatality rates for all diagnoses, the enteritis, and the pneumonia were 11.8 %, 17.9 %, and 9.4% in average, respectively. Average daily gain rates, from birth to 16 weeks of age differed between farms with inadequate calf housing (0.8 kg/d) versus farms with adequate calf housing (1.0 kg/d). The most common pathogens isolated from calves that died of the enteritis were rotavirus (five calves), and Escherichia coli (four calves). Pathogens isolated from the pneumonic lungs included Pasteurella multocida (three calves), Haemophilus somnus (three calves), and Pasteurella haemolytica (one calf). These pathogens are similar to those detected in our study. In another study, a survey identified the herd management practices were focused to the occurrence of the enteritis, the pneumonia, or death between birth and 16 weeks of age. Calves that required assisted delivery were at an increased risk of developing

the enteritis sooner than calves born without assistance (Griffin et al., 1993; Sivula et al., 1996b). No other risk factors had a significant effect.

Average daily gain in healthy calves of the Slovak Simmental breed reached 0.704 kg during the breeding period what is consistent with requirement for breeding aim and breeding standard of this breed (Strapák et al., 2005). Comparable growth intensity in Holstein breed during the breeding period was reported (Van Amburgh, 1998; Marston et al., 1992; Delavaud et al., 2002). Similar daily gain in heifers (814 g) was found in heifers breeding population of Fleckvieh (Simmental) breed in Germany (Kogel et al., 2000). The average daily gain (0.881 kg) in Austrian heifers of Fleckvieh breed (Bene and Szabo, 2005) is higher than in heifers in this study (+0.053 kg). In our paper we have not found considerable difference in average daily gain between animals affected by diarrhea and healthy ones. The hypothesis about effect of negative effect of diarrhea on growth was not confirmed nor for calves nor for heifers. But result of milk production is relatively surprising. We have expected decreasing production in relation to this diseases, following the published hypotheses The conclusions and hypotheses of Holstein breeders stating that the enteritis decreases the dairy production after first lactation have not been confirmed. If the calves had divided to two groups B (B1 – one time diarrhea, B2 – two or more times diarrhea) analysis would show the considerable difference among subgroups B2 and groups A and C, this is a hypothesis for future investigation.

The pneumonia is, after the diarrhea, the second most frequent disease in young calves (Jensen et al., 1976; Ayroud et al., 2000). In calf breeding, this disease occurs most frequently in the age of 8-12 weeks (Van Donkersgoed et al., 1993). Respiratory syndrome in calves and young cattle has a significant effect on direct and in-direct losses of producers (Hasoksuz et al., 2005; Lathrop et al., 2000; Thompson et al., 2006).

Similar results regarding the effects of the pneumonia (cumulative incidence 25 %), diarrhea (29 %), umbilical infection (14 %), and umbilical hernia (15 %) on body weight and height gains during the first 3 months of life were published (Virtala et al., 1996). Use of multiple linear regressions with farms treated as random, effects indicated, that treated, verified the pneumonia was associated with a reduction in average daily gain of 66 g and that a failure of passive transfer reduced average daily gain of 48 g during the first month. During the second month, neither disease nor failure of passive transfer affected average daily gain. During the third month, each additional week of the pneumonia reduced average daily gain by 14 g, and umbilical infection reduced average daily gain by 96 g. Each additional week of the diagnosed the pneumonia reduced total body weight gain during the first 3 months by 0.8 kg. In general, prevention of the chronic pneumonia and the umbilical infection may improve the average daily gain of calves. Our study confirms the negative effect of the pneumonia to growth. The effect to milk production was not considerable. Productivity in animals considered as “health” could be affected by subclinical disease too.

Conclusion

Our results not show the negative influence of gastrointestinal disease manifested in diarrhea to daily gain of calves, heifers and milk production traits of cows at first lactation in Slovak Simmental breed. Considerable negative effect to growth parameters in calves and heifers was found for the pneumonia occurrence from born

to 6 th months of age. Negative effect of the pneumonia to milk production at first lactation was not confirmed.

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Table 1. Testing scheme of growth and dairy production parameters

Group of animals	Calves 0 – 6 months	Heifers 7 – 25 months	Cows 1st lactation
Group A	Birth weight Body weight Daily gain	Body weight Daily gain	Milk kg Fat % and kg Protein % and kg
Group B	Birth weight Body weight Daily gain	Body weight Daily gain	Milk kg Fat % and kg Protein % and kg
Group C	Birth weight Body weight Daily gain	Body weight Daily gain	Milk kg Fat % and kg Protein % and kg

A = healthy calves; control group
B = calves which suffered from enteritis once of more times from birth to 6th month of age
C = calves which suffered from pneumonia from birth to 6th month of age

Table 2. Average daily gain of calves – from born to 6th month of age.

Group of calves	N	Mean [g]	SD
A	863	703.91^{a}	223.48
B	292	690.40^{a,b}	186.18
C	172	636.80^{b}	221.19

Mean values in same columns with different superscripts are different on P < 0.05 significance level.
A = healthy calves; control group
B = calves which suffered from enteritis once of more times from birth to 6th month of age
C = calves which suffered from pneumonia from birth to 6th month of age

Table 3. Average daily gain of heifers – breeding period from 7 to 25 months of age.

Group of heifers	N	Mean [g]	SD
A	863	828.31^{a}	89.16
B	292	830.01^{a}	73.57
C	172	784.64^{b}	102.96

Mean values in same columns with different superscripts are different on P < 0.05 significance level.
A = heifers comes from healthy calves; control group
B = heifers comes from calves which suffered from enteritis once of more times from birth to 6th month of age

C = heifers comes from calves which suffered from pneumonia from birth to 6th month of age

Table 4. Milk production traits of cows in first lactation

Group of cows	N		Milk (kg)	Fat (%)	Fat (kg)	Proteins (%)	Proteins (kg)
A	863	Mean	5 800[a]	4.82	280.34	3.39	196.16
		SD	3.96	3.36	4.54	7.55	3.83
B	292	Mean	5 977[a]	4.94	295.96	3.37	201.34
		SD	4.31	3.22	4.68	2.5	4.25
C	172	Mean	5 674[a]	4.85	276.08	3.40	191.50
		SD	3.87	3.03	4.53	2.83	3.67

Mean values in same columns with different superscripts are different on P < 0.05 significance level.

A = cows from healthy calves; control group

B = cows from calves which suffered from enteritis once of more times from birth to 6th month of age

C = cows comes from calves which suffered from pneumonia from birth to 6th month of age