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*Source / Izvornik:* **Mljekarstvo : časopis za unaprjeđenje proizvodnje i prerade mlijeka, 2018, 68, 77 - 84**

**Journal article, Published version**
**Rad u časopisu, Objavljena verzija rada (izdavačev PDF)**

https://doi.org/10.15567/mljekarstvo.2018.0201

Original scientific paper - Izvorni znanstveni rad UDK: 637.112

# Metabolic disorders in dairy Simmentals - prevalence risk and effect on subsequent daily milk traits

doi: 10.15567/mljekarstvo.2018.0201

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Received - Prispjelo: 20.09.2017.
Accepted - Prihvaćeno: 20.02.2018.

**Abstract**

In order to analyse metabolic disorders in Simmental cows, 2.641.223 test-day records have been used. The metabolic disorders prevalence risk was indicated by the fat to protein (F/P) ratio, while the subclinical disorder was demonstrated using the F/P ratio and daily production. In terms of the ketosis prevalence risk (KPR), the highest prevalence risks occurred at the 20$^{th}$ lactation day in all tested cows with exception of cows in parity P4+ which experienced peak prevalence risk at 25$^{th}$ lactation day. A steady decrease of KPR after peak prevalence was observed in all animals except the 3$^{rd}$ lactation cows which experienced the second peak prevalence at the 30$^{th}$ lactation day, after which the prevalence risk continued to decline. The highest acidosis prevalence risk (APR) was detected among 4+ parity cows. Considering the lactation stage, the highest APR occurred within the first 10 days, with the indication from 16 to 23 %, depending on parity. The peak prevalence risk was followed by a considerable decline during the ensuing 20 days. The prevalence risk began to increase among all cows after the 25$^{th}$ lactation day. Furthermore, there was a considerable decrease in a daily milk yield and variation of daily milk contents due to subclinical disorders. The most noticeable drop in daily milk yield, for both ketosis/acidosis, was detected in cows in 4+ parity in the amounts of 7.45 kg/day and 2.73 kg/day respectively. There was also a production decline in the subsequent milk controls. Subclinical disorders can also substantially change daily milk contents. The daily fat content was considerably reduced by the subclinical ketosis and the same parameter was considerably increased by the subclinical acidosis. The opposite trends were detected for daily protein content. Since indication criteria was set on Holstein population and considering the fact that Simmental cows produce noticeably less, some adjustment is needed before a routine use of test-day records for early detection of metabolic disorders in dairy Simmental herds.

*Key words*: Simmentals, metabolic disorders, prevalence risk, test day records

## Introduction

In order to be efficient, dairy cattle farm production system requires annual gravidity and calving. The transition period, i.e. the shift from the pregnant, nonlactating, stage to the nonpregnant, lactating stage is often fairly stressful for animals. Le Blanc (2010) corroborated that by observing that many metabolic disorders (up to 50 %) of dairy cows happen within the first 15 days of lactation. During the transition period, there is a predisposition of dairy cows towards various disorders due to different

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factors such as dietary changes, negative energy balance, decreased feed intake, weight loss, hypocalcemia, etc. The most common disorders in lactating dairy cows include sub/clinical ketosis/acidosis.

Ketosis is a metabolic disorder that can occur both, in clinical and subclinical forms. Subclinical ketosis is defined as a preclinical stage of ketosis. Clinical ketosis usually occurs in high producing cows in period between the 2nd and the 7th week of lactation due to inadequate nutrition and management (Gillund et al., 2001). Different factors such as breed, parity, season and herd-related factors can influence the prevalence of ketosis. According to Dohoo and Martin (1984), the lactational incidence risk of ketosis was between 1.1 and 9.2 %, while Rajala-Schultz et al. (1999) detected the incidence risk in the interval between 2.5 to 4.2 %, depending on parity. According to Gustafsson and Emanuelson (1996) as well as Rajala and Gröhn (1998), clinical ketosis makes economic losses to dairy farmers by means of treatment costs, decreased milk production, impaired reproduction efficiency and increased involuntary culling.

During the last decade, subacute ruminal acidosis (SARA) has become a growing problem in well-managed, high-producing dairy herds. Therefore, the monitoring of dairy cows for SARA signs became extremely important. Across the USA, the reported prevalence of subacute ruminal acidosis has reached 19 % of cows in early lactation and 26 % of cows in mid-lactation. Bramley et al. (2005) and O'Grady et al. (2008) detected that SARA occured in 10 % to 15 % of dairy cows grazing perennial ryegrass-based pastures. The highest prevalence of SARA was detected in early lactating as well as in cows at peak dry matter (DM) intake. According to Dirksen et al. (1985), there is a greater degree of risk in case of early lactation cows because of reduced absorptive capacity of the rumen, poorly adapted rumen micro flora, and the rapid introduction to high-energy dense diets. Oetzel (2005) stated that due to the greater amount of acids produced in the rumen, the cows at peak DM intake face increased risks. Discussing SARA diagnosis, Enemark (2008) observed that recent developments in technology lead to the use of in-dwelling rumen pH probes, the use of rumen valerate and urinary net acid base excretion.

The health of dairy cows has to be monitored at the herd level. Duffiled et al. (1997) and Eicher (2004) suggested that in case of dairy herd health monitoring, test-day records (TDR) offer an alternative which is much more cost effective and non-invasive as opposed to specific diagnostic. TDR include daily milk, fat and protein production as well as fat to protein ratio (F/P ratio). According to Gravert (1991), the ideal range for F/P ratio is 1-1.25, while according to Duffield et al. (1997), 1.33 is the upper margin. According to Haas and Hofirek (2004), F/P ratio that is higher than 1.4 shows energy deficit and, if ketone bodies are present, subclinical ketosis. Richardt (2004) determined a 1.5 value of F/P ratio as the risk level for subclinical ketosis, while Eicher (2004) considered beside the F/P ratio, the daily milk production as well, in order to find the indication of metabolic disorders (acidosis, ketosis). In addition, Kasarda and Vlček (2016) detected that F/P ratio, apart from metabolic status, could also be used as a non-invasive method for indicating claw disorders.

These disorders have been carefully examined for dairy cattle breeds, but there are only few findings for Simmentals (Djoković et al., 2013) Hence, the objectives of this study were to determine the prevalence risk of metabolic disorders during lactation as well as the effect of subclinical disorders on daily milk traits of Simmentals using the test-day records.

## Material and methods

Individual test day records gathered in regular milk recording from 1/2004 to 12/2013 on dairy farms in Croatia were used in statistical analysis. In Croatia, milk recording performs according to the alternative milk recording method (AT4/BT4), i.e. monthly measurement of milk yield during the evening/ morning milkings and milk sampling from every cow is being considered. The daily milk yield and the fat content are projected from a partial measurement. The ICAR standards (2003) were used for the logical control of milk data. Tab. 1 shows the variability of daily milk traits (yield and contents) regarding the parity class. All the records with lactation stage in (< 1 days and > 305 days), missing or nonsense parity, test date, calving date, owner and region value were deleted from dataset. After logical control, data consisted of 2.641.223 test-day records of milk, fat, and protein from 164.972 Simmental cows reared on 14.664 farms in Croatia. According to the parity, four classes were formed: P1, P2, P3, and P4+ that included cows in the 4th and higher lactations. In terms of the lactation stage, 16 classes by 5 days were formed as follows: L1 (< 10)… L16 (> 90). In terms of the test date, month-year classes were formed (1/2004, 2/2004 … 11/2013, 12/2013).

The F/P ratio indicated the prevalence risk of the metabolic disorders (ketosis/acidosis). The F/P≥1.5 was used as an indicator of ketosis prevalence risk, while F/P<1.0 was used as an indicator of acidosis prevalence risk. The metabolic disorders prevalence risk was calculated as the frequency of cows indicated with risk in total number of cows with regard to lactation stage classes considering the parity class. Following Eicher's (2004) recommendations, subclinical disorder (ketosis/acidosis) was indicated by the F/P ratio and the daily production of cows. Also, the F/P≥1.5 in cows that yielded between 33 to 50 kg/day was used as an indicator of subclinical ketosis, while F/P<1.0 in cows that yielded between 20 to 43 kg/day was used as an indicator of subclinical acidosis. Further analyses included only cows with detected subclinical disorder.

Daily milk yield and contents that were measured on the test day when subclinical disorder occurred were used as the reference level. The disorder index was defined considering the number of days following the subclinical disorder indication as follows: D-0= test-day record when subclinical disorder was indicated, A-1= within 35 days, A-2= between 36 and 70 days, A-3= between 71 and 105 days, and A-4= more than 105 days. The effect of subclinical disorders (ketosis/acidosis) on daily milk yield and contents were studied individually for each parity class using the following statistical model:

$$y_{ijklm} = \mu + b_1(d_i/305) + b_2(d_i/305)^2 + b_3\ln(305/d_i) + b_4\ln^2(305/d_i) + S_j + R_k + H_l + e_{ijklm}$$

$y_{ijklm}$ = the estimated daily milk trait;

$\mu$ = intercept;

$b_1$, $b_2$, $b_3$, $b_4$ = regression coefficients (lactation curve by Ali-Schaeffer (Ali and Schaeffer, 1987));

$d_i$ = days in milk;

$S_j$ = fixed effect of month-year j (j = 1/2004 to 12/2013);

$R_k$ = fixed effect of the region k (k = Croatian counties);

$D_l$ = fixed effect of disorder index l (l = D–0, A–1, A–2, A–3, A–4);

$e_{ijklm}$ = residual.

The significance of the differences between the disorder index levels was tested by Scheffe's method of multiple comparisons using the MIXED procedure of SAS (SAS Institute Inc., 2008).

Table 1. Basic statistics of daily milk traits according to parity

| | DMY kg | | | DFC % | | | DPC % | | | FPR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parity | Mean | SD | CV | Mean | SD | CV | Mean | SD | CV | Mean | SD | CV |
| 1 | 15.7 | 5.1 | 32.6 | 4.22 | 0.9 | 21.3 | 3.41 | 0.4 | 12.5 | 1.2 | 0.3 | 21.7 |
| 2 | 16.7 | 6.0 | 36.2 | 4.23 | 0.9 | 22.2 | 3.42 | 0.4 | 12.8 | 1.2 | 0.3 | 22.6 |
| 3 | 17.1 | 6.2 | 36.3 | 4.12 | 0.9 | 22.7 | 3.41 | 0.4 | 12.9 | 1.2 | 0.3 | 23.4 |
| 4+ | 16.1 | 5.8 | 36.0 | 4.14 | 1.0 | 23.4 | 3.43 | 0.4 | 12.8 | 1.2 | 0.3 | 24.2 |
| Total | 16.3 | 5.8 | 35.5 | 4.13 | 0.9 | 22.5 | 3.42 | 0.4 | 12.8 | 1.2 | 0.3 | 23.1 |

*DMY - daily milk yield; DFC - daily fat content; DPC - daily protein content; FPR - fat to protein ratio

## Results and discussion

Fig. 1 shows the variability of subclinical ketosis (SCK) prevalence risk regarding the lactation stage and parity in Simmental cows. The highest prevalence risks occurred at the 20$^{th}$ lactation day in cows in parity classes P1, P2 and P3, while cows in parity P4+ experienced peak prevalence risk at the 25$^{th}$ lactation day. Hence, to determine the SCK prevalence risk based on F/P ratio during the first two weeks of lactation could be beneficial (Iwersen et al., 2009). Heuer et al. (1999) stated that the first test day record (daily milk yield and F/P ratio) was a more reliable predictor of disorders, fertility and milk yield than the loss of body condition scoring. According to Suthar et al. (2013), the prevalence of SCK was high between 2 to 15 days in milk. Koeck et al. (2013) determined that 87 % of ketosis cases in Holstein cows were recorded during the first 30 days of lactation, while according to Djoković et al. (2013), the early lactation Simmental cows showed metabolic disturbances associated with ketosis and a certain degree of hepatic lesions. In this research, the 3$^{rd}$ lactation cows had the highest ketosis prevalence risk during all lactation except the first 15 days when the 1$^{st}$ parity cows experienced the highest risk. More frequent ketosis prevalence in multiparous cows compared to primiparous cows was also determined by Carrier et al. (2004) as well as by Gantner et al. (2009). Also, Andersson and Emanuelson (1985) as well as Duffield et al. (1997) determined that the levels of ketosis increase with parity. A steady decrease of ketosis prevalence risk after peak prevalence was detected in all Simmentals except the 3$^{rd}$ lactation cows, which experienced second peak prevalence at the 30$^{th}$ lactation day, after which the prevalence risk continued to drop. Similar trends, but involving higher values of prevalence risk were determined in Holstein cows in Croatia (Gantner et al., 2016). This implies that Simmental cows could be more resistant to subclinical ketosis prevalence.

Compared to ketosis prevalence risk, the acidosis prevalence risk indicated by the daily F/P<1.0 showed higher variability (Fig. 2). The highest acidosis prevalence risk was detected in 4$^{+}$ parity Simmentals during all lactation. According to the previous research (Dirksen et al., 1985; Bramley et al., 2005; Oetzel, 2005; O'Grady et al., 2008), this study determined the highest acidosis prevalence risk in Simmentals at the beginning of the lactation (amounting to 16-24 % depending of the parity) with the downward trend till the 25$^{th}$ lactation day after which the increase was detected. In a research on Holstein breed (Gantner et al., 2016), were

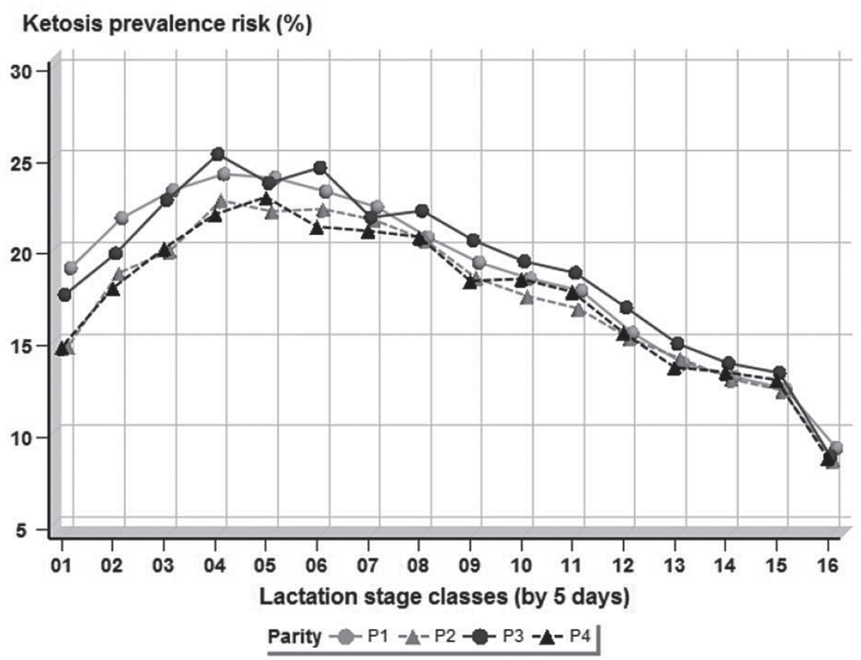


Figure 1. Ketosis prevalence risk (%) in accordance to lactation stage and parity classes

detected similar trends, but involving higher frequency of cows in prevalence risk.

For each parity class, Tab. 2 shows the evaluation of the effect of subclinical disorders (ketosis, acidosis) on daily milk yield and contents indicated by the F/P ratio and the daily milk yield. All effects included in the statistical model proved to be very significant ($p<0.01$). Subclinical ketosis considerably decreased the daily milk yield in all Simmental cows within 35 days after detection. The amount of decrease, considering the parity, was as follows 7.07 kg/day; 4.82 kg/day; 5.36 kg/day; and 7.45 kg/day (i.e., parities 1, 2, 3, and 4+). Subsequent milk controls showed the continuation of the negative effect of subclinical ketosis. According to Toni et al. (2011), cows with F/P ratio in interval (< 1; > 2) showed a consistently lower milk production. Rajala-Schultz et al. (1999) determined that the average total loss per cow was over 300 kg/lactation due to ketosis prevalence. According to McArt et al. (2012), cows with subclinical ketosis, when compared to non-ketotic cows, produced daily 3.4-6% less milk during the first 30 days of lactation. In a later research, McArt et al. (2013) and Ospina et al. (2010) confirmed a considerably lower milk production in the first month of lactations. Considering the influence of parity, Gantner et al. (2009) reported the highest drop in daily milk yield due to subclinical ketosis in the first lactation of the Slovenian Holstein.

There was a noticeable decrease of daily fat content detected in all cows which is most probably related to subclinical ketosis within 35 days after the indication date. Thereby the highest drop was observed in 4+ parity cows. The variation of daily protein content was statistically significant, but lower when compared to the daily fat content. The increase of daily protein content due to subclinical ketosis amounted to about 0.1 %, while the decrease of fat content amounted to more than 1 %. Because of the variability trend of the daily fat and protein contents, the daily fat/protein ratio significantly dropped within 35 days after the subclinical ketosis indication, too.

Talking about subclinical acidosis, a considerable negative effect on daily milk yield and daily protein content was detected regardless of the parity. Daily milk yield, regarding the parity, considerably dropped within 35 days after the subclinical acidosis detection date in the amount of 2.34 kg/day; 2.08 kg/day; 2.05 kg/day; and 2.73 kg/day (parity 1, 2, 3 and 4+). In subsequent milk controls, a production decline in all cows was also detected. Studying Croatian Holsteins, Gantner et al. (2016) pointed out similar trends in the subsequent milk recordings, but involving smaller differences in daily milk traits.

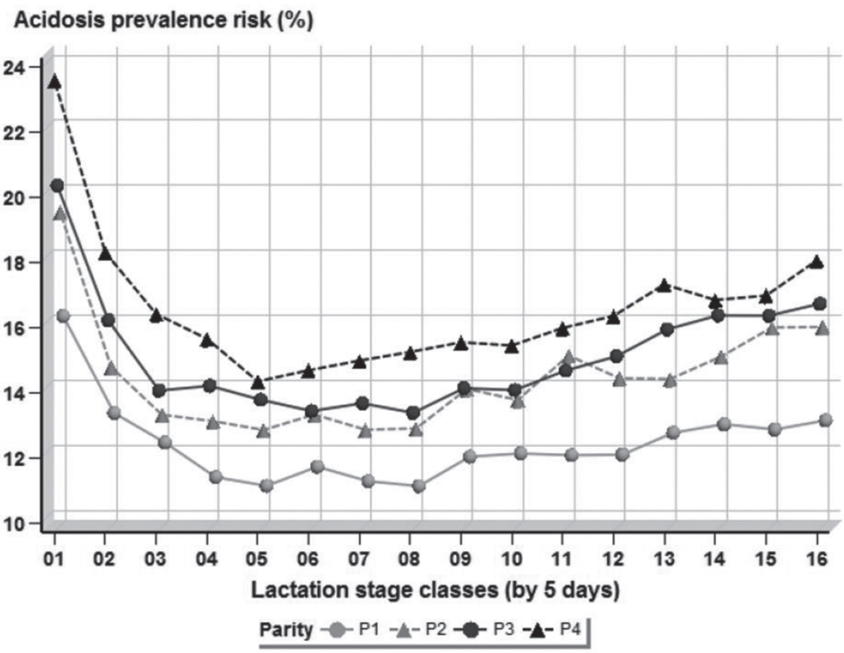


Figure 2. Acidosis prevalence risk (%) in accordance to lactation stage and parity classes

Table 2. Effect of subclinical disorders (ketosis, acidosis) on daily milk traits according to parity

| Metabolic disorder index | Parity 1 | | Parity 2 | | Parity 3 | | Parity 4+ | |
|---|---|---|---|---|---|---|---|---|
| | KET | ACI | KET | ACI | KET | ACI | KET | ACI |
| | Daily milk yield (kg) | | | | | | | |
| D-0 | $33.70^{A}$ | $22.45^{A}$ | $32.41^{A}$ | $23.29^{A}$ | $33.50^{A}$ | $23.11^{A}$ | $31.28^{A}$ | $22.03^{A}$ |
| A-1 | $26.63^{B}$ | $20.11^{B}$ | $27.59^{B}$ | $21.21^{B}$ | $28.14^{B}$ | $21.06^{B}$ | $23.83^{B}$ | $19.30^{B}$ |
| A-2 | $26.17^{BC}$ | $19.76^{C}$ | $26.13^{C}$ | $20.46^{C}$ | $26.63^{C}$ | $20.34^{C}$ | $23.51^{B}$ | $18.75^{C}$ |
| A-3 | $24.74^{BC}$ | $18.92^{D}$ | $25.27^{CD}$ | $19.58^{D}$ | $25.10^{D}$ | $19.44^{D}$ | $23.11^{B}$ | $18.17^{D}$ |
| A-4 | $24.08^{C}$ | $17.95^{E}$ | $24.33^{D}$ | $18.31^{E}$ | $24.04^{E}$ | $18.08^{E}$ | $23.02^{B}$ | $17.39^{E}$ |
| | Daily fat content (%) | | | | | | | |
| D-0 | $5.30^{A}$ | $2.99^{A}$ | $5.37^{A}$ | $3.04^{A}$ | $5.20^{A}$ | $2.97^{A}$ | $5.21^{A}$ | $2.98^{A}$ |
| A-1 | $4.39^{B}$ | $3.80^{B}$ | $4.36^{B}$ | $3.92^{B}$ | $4.25^{B}$ | $3.90^{B}$ | $4.15^{B}$ | $3.91^{B}$ |
| A-2 | $4.39^{B}$ | $3.79^{B}$ | $4.32^{B}$ | $3.86^{C}$ | $4.22^{B}$ | $3.81^{C}$ | $4.13^{B}$ | $3.88^{B}$ |
| A-3 | $4.36^{B}$ | $3.87^{CD}$ | $4.27^{B}$ | $3.94^{B}$ | $4.16^{B}$ | $3.89^{B}$ | $4.12^{B}$ | $3.89^{B}$ |
| A-4 | $4.13^{B}$ | $3.90^{D}$ | $4.21^{B}$ | $3.94^{B}$ | $4.14^{B}$ | $3.90^{B}$ | $4.11^{B}$ | $3.88^{B}$ |
| | Daily protein content (%) | | | | | | | |
| D-0 | $3.22^{A}$ | $3.45^{A}$ | $3.21^{A}$ | $3.53^{A}$ | $3.23^{A}$ | $3.45^{A}$ | $3.18^{A}$ | $3.43^{A}$ |
| A-1 | $3.30^{AB}$ | $3.40^{B}$ | $3.31^{B}$ | $3.48^{B}$ | $3.33^{B}$ | $3.41^{B}$ | $3.30^{B}$ | $3.36^{B}$ |
| A-2 | $3.32^{AB}$ | $3.39^{B}$ | $3.35^{BC}$ | $3.48^{B}$ | $3.36^{B}$ | $3.40^{B}$ | $3.33^{C}$ | $3.36^{B}$ |
| A-3 | $3.35^{B}$ | $3.40^{B}$ | $3.39^{CD}$ | $3.48^{B}$ | $3.38^{B}$ | $3.40^{B}$ | $3.38^{D}$ | $3.36^{B}$ |
| A-4 | $3.37^{B}$ | $3.39^{B}$ | $3.42^{D}$ | $3.49^{B}$ | $3.40^{B}$ | $3.41^{B}$ | $3.39^{D}$ | $3.35^{B}$ |
| | Fat/protein | | | | | | | |
| D-0 | $1.68^{A}$ | $0.86^{A}$ | $1.70^{A}$ | $0.85^{A}$ | $1.65^{A}$ | $0.85^{A}$ | $1.67^{A}$ | $0.86^{A}$ |
| A-1 | $1.35^{B}$ | $1.12^{B}$ | $1.33^{B}$ | $1.14^{B}$ | $1.29^{B}$ | $1.15^{B}$ | $1.27^{B}$ | $1.17^{C}$ |
| A-2 | $1.33^{B}$ | $1.12^{B}$ | $1.30^{BC}$ | $1.12^{C}$ | $1.27^{B}$ | $1.13^{C}$ | $1.25^{BC}$ | $1.16^{B}$ |
| A-3 | $1.31^{B}$ | $1.14^{CD}$ | $1.27^{C}$ | $1.14^{B}$ | $1.24^{B}$ | $1.15^{B}$ | $1.23^{C}$ | $1.17^{BC}$ |
| A-4 | $1.23^{BC}$ | $1.15^{D}$ | $1.24^{C}$ | $1.14^{B}$ | $1.23^{B}$ | $1.15^{B}$ | $1.22^{BC}$ | $1.17^{BC}$ |

*values within the same column marked with different letter differ statistically highly significant ($P<0.01$)

## Conclusions

According to the results of this research, a considerable drop of daily milk yield and variation of daily milk contents in cases when F/P ratio ≥1.5 in Simmentals that yielded between 33 to 50 kg/day (subclinical ketosis) as well as when F/P<1.0 in Simmentals that yielded between 20 to 43 kg/day (subclinical acidosis) could be expected. Also, a production decline in the subsequent milk controls after the detection of both disorders could be expected.

In general, metabolic disorders prevalence usually leads to high financial losses as a result of increased treatment costs, decreased milk production, impaired reproduction efficiency, and increased involuntary culling. Test-day records proved to be a useful, cost effective and non-invasive method for monitoring the health of herds, thus making it possible for farmers to react early and prevent the development of strong clinical symptoms. This could be the way to considerably decrease or completely avoid farmers' economic losses as well as cows' malaise. Since defined the production criteria based on Holstein cows, considering the fact that Simmental cows produce noticeably less than Holstein cows, the evaluation criteria require some adjustment so that a more accurate detection could be achieved.

## *Metabolički poremećaji u mliječnih krava simentalske pasmine - rizik pojavnosti te utjecaj na svojstva mliječnosti pri sljedećoj kontroli*

U cilju analize metaboličkih poremećaja u krava simentalske pasmine korišteno je 2641223 zapisa na kontrolni dan. Rizik pojavnosti metaboličkih poremećaja indiciran je omjerom mliječne masti i bjelančevina (F/P) dok je subklinički poremećaj definiran F/P omjerom i dnevnom proizvodnjom. Najviša vrijednost rizika pojavnosti ketoze (KPR) utvrđena je 20. dana laktacije u svih krava izuzev onih u 4+ laktaciji kada je najveća vrijednost utvrđena pri 25. danu. Lagani pad KPR nakon utvrđenog maksimuma utvrđen je u svih grla uz izuzetak krava u 3. laktaciji u kojih je utvrđen drugi maksimum u 30. danu laktacije nakon čega u istih slijedi kontinuirani pad rizika pojavnosti. Najviši rizik pojavnosti acidoze (APR) utvrđen je u krava u 4+ laktaciji. Obzirom na stadij laktacije, najviši APR utvrđen je unutar prvih 10 dana laktacije i to, ovisno o redoslijedu laktacije, u 16-23 % analiziranih krava. Nakon utvrđenog maksimalnog APR slijedio je značajan pad rizika tijekom narednih 20 dana, te ponovni porast nakon 25. dana laktacije. Nadalje, utvrđen je značajan pad dnevne količine mlijeka te varijabilnost dnevnog sastava mlijeka kao posljedica subkliničkih poremećaja. Najizraženiji pad dnevne količine mlijeka uslijed ketoze/acidoze u iznosu od 7,45 kg/dan / 2,73 kg/dan utvrđen je u krava u 4+ laktaciji. Također je utvrđen pad proizvodnje i pri sljedećim kontrolama mliječnosti. Dnevni sadržaj mliječne masti značajno je reduciran uslijed subkliničke ketoze, dok je pri subkliničkoj acidozi utvrđen značajan porast. Suprotni su trendovi utvrđeni za dnevni sadržaj proteina. Uzimajući u obzir da su kriteriji indikacije postavljeni na populaciji krava holstein pasmine, te uvažavajući činjenicu da krave simentalske pasmine proizvode značajno manje mlijeka od holstein grla, potrebne su određene korekcije prije rutinske uporabe zapisa na kontrolni dan u svrhu rane detekcije metaboličkih poremećaja u stadima mliječnih krava simentalske pasmine.


*Ključne riječi:* simentalska pasmina, metabolički poremećaji, rizik pojavnosti, zapis na kontrolni dan

## References


1. Ali, T.E., Schaeffer, L.R. (1987): Accounting for covariances among test day milk yields in dairy cows. *Canadian Journal of Animal Science* 67, 637-644. https://doi.org/10.4141/cjas87-067
2. Andersson, L., Emanuelson, U. (1985): An epidemiological study of hyperketonaemia in Swedish dairy cows; Determinants and the relation to fertility. *Preventive Veterinary Medicine* 3, 449-462. https://doi.org/10.1016/0167-5877(85)90006-6
3. Bramley, E., Lean, I.J., Costa, N.D., Fulkerson, W.J. (2005): Acidosis in pasture fed dairy cows: risk factors and outcomes. *Journal of Dairy Science* 88, 95.
4. Carrier, J., Stewart, S., Godden, S., Fetrow, J., Rapnicki, P. (2004): Evaluation and use of three cow side tests for detection of subclinical ketosis in early postpartum cows. *Journal of Dairy Science* 87, 3725-3735. https://doi.org/10.3168/jds.S0022-0302(04)73511-0
5. Dirksen, G., Liebich, H., Mayer, H. (1985): Adaptive changes of the ruminal mucosa and functional and clinical significance. *Bovine Practice* 20, 116-120.
6. Djoković, R., Kurćubić, V., Ilić, Z., Cincović, M., Petrović, M. Fratrić, B., Jašovi, B., Jašović (2013): Evaluation of metabolic status in Simmental dairy cows during late pregnancy and early lactation. *Veterinarski Arhiv* 83 (6), 593-602.
7. Dohoo, I.R., Martin, S.W. (1984): Subclinical ketosis: prevalence and associations with production and disease. *Canadian Journal of Comparative Medicine*, 48 (1), 1-5
8. Duffield, T.F, Kelton, D.F., Leslie, K.E., Lissemore, K.D., Lumsden, J.H. (1997): Use of test day milk fat and milk protein to detect subclinical ketosis in dairy cattle in Ontario. *Canadian Veterinary Journal* 38, 713-718.
9. Eicher, R. (2004): Evaluation of the metabolic and nutritional situation in dairy herds: Diagnostic use of milk components, 23rd World Buiatrics Congress, Québec, Canada, July 11-16.
10. Enemark, J.M.D. (2008): The monitoring, prevention and treatment of subacute ruminal acidosis (SARA) - a review. *The Veterinary Journal* 176 (1), 32-43. https://doi.org/10.1016/j.tvjl.2007.12.021
11. Gantner, V., Potočnik, K., Jovanovac, S. (2009): Test-day records as a tool for subclinical ketosis detection. *Acta Veterinaria (Beograd)* 59 2-3, 185-191.
12. Gantner, V., Bobić, T., Potočnik, K. (2016): Prevalence of metabolic disorders and effect on subsequent daily milk quantity and quality in Holstein cows. *Archive Animal Breeding* 2, 1-6. https://doi.org/10.5194/aab-59-381-2016
13. Gillund, P., Reksen, O., Gröhn, Y.T., Karlberg, K. (2001): Body condition related to ketosis and reproductive performance in Norwegian dairy cows. *Journal of Dairy Science* 84 (6), 1390-1396. https://doi.org/10.3168/jds.S0022-0302(01)70170-1

14. Gravert, H.O. (1991): Indicators for assessment of energy balance in high-yielding cows. *Monatsh Veterinarmed* 46, 536-537.
15. Gustafsson, A.H., Emanuelson, U. (1996): Milk acetone concentration as an indicator of hyperketonaemia in dairy cows: The critical value revised. *Animal Science* 63, 183-188. https://doi.org/10.1017/S1357729800014739
16. Haas, D., Hofírek, B. (2004): The diagnostic importance of milk components for a human and cows' health, CUA Prague, Proceedings of contributions: Milk day, 26-29.
17. Heuer, C., Schukken, Y.H., Dobbelaar, P. (1999): Postpartum body condition score and results from the first test day milk as predictors of disease, fertility, yield, and culling in commercial dairy herds. *Journal of Dairy Science* 82 (2), 295-304. https://doi.org/10.3168/jds.S0022-0302(99)75236-7
18. ICAR - International Committee for Animal Recording, 2003 - Guidelines approved by the General Assembly held in Interlaken, Switzerland, on 30 May 2002, Roma, 19-39.
19. Kasarda, R., Vlček, M. (2016): Analysis of relationship between claw disorders, metabolic status and milk yield. Fourth Dairy Care Conference 2016. Lisabon, Spain, October 13th and 14th.
20. Koeck, A., Miglior, F., Jamrozik, J., Kelton, D.F., Schenkel, F.S. (2013): Genetic associations of ketosis and displaced abomasum with milk production traits in early first lactation of Canadian Holsteins. *Journal of Dairy Science* 96 (7), 4688-4696. https://doi.org/10.3168/jds.2012-6408
21. LeBlanc, S. (2010): Monitoring metabolic health of dairy cattle in the transition period. *Journal of Reproduction and Development* 56, 29-35. https://doi.org/10.1262/jrd.1056S29
22. McArt, J.A., Nydam, D.V., Oetzel, G.R. (2012): Epidemiology of subclinical ketosis in early lactation dairy cattle. *Journal of Dairy Science* 95 (9), 5056-5066. https://doi.org/10.3168/jds.2012-5443
23. McArt, J.A., Nydam, D.V., Oetzel, G.R. (2013): Dry period and parturient predictors of early lactation hyperketonemia in dairy cattle. *Journal of Dairy Science* 96 (1), 198-209. https://doi.org/10.3168/jds.2012-5681
24. Oetzel, G.R. (2005): Applied aspects of ruminal acidosis induction and prevention. *Journal of Dairy Science* 88, 643.
25. O'Grady, L., Doherty, M.L., Mulligan, F.J. (2008): Subacute ruminal acidosis (SARA) in grazing dairy cows. *The Veterinary Journal* 176 (1), 44-49. https://doi.org/10.1016/j.tvjl.2007.12.017
26. Ospina, P.A., Nydam, D.V., Stokol, T., Overton, T.R. (2010): Association between the proportion of sampled transition cows with increased nonesterified fatty acids and β-hydroxybutyrate and disease incidence, pregnancy rate, and milk production at the herd level. *Journal of Dairy Science* 93 (8), 3595-3601. https://doi.org/10.3168/jds.2010-3074
27. Rajala, P.J., Grohn, Y.T. (1998): Effects of dystocia, retained placenta, and metritis on milk yield in dairy cows. *Journal of Dairy Science* 81/12, 3172-3181. https://doi.org/10.3168/jds.S0022-0302(98)75883-7
28. Rajala-Schultz, P.J., Grohn, Y.T., Mcculloch, C.E. (1999): Effects of milk fever, ketosis, and lameness on milk yield in dairy cows. *Journal of Dairy Science* 82 (2), 288-294. https://doi.org/10.3168/jds.S0022-0302(99)75235-5
29. https://www.ncbi.nlm.nih.gov/pubmed/10068950
30. Richardt, W. (2004): Milk composition as an indicator of nutrition and health, *The Breeding* 11, 26-27.
31. SAS 9.2. (2008) SAS/STAT User's Guide. Cary, NC, USA: SAS Institute Inc.
32. Suthar, V.S., Canelas-Raposo, J., Deniz, A., Heuwieser, W. (2013): Prevalence of subclinical ketosis and relationships with postpartum diseases in European dairy cows. *Journal of Dairy Science* 96 (5), 2925-2938. https://doi.org/10.3168/jds.2012-6035
33. Toni, F., Vincenti, L., Grigoletto, L., Ricci, A., Schukken, Y.H. (2011): Early lactation ratio of fat and protein percentage in milk is associated with health, milk production, and survival. *Journal of Dairy Science* 94 (4), 1772-1783. https://doi.org/10.3168/jds.2010-3389