THE OCCURRENCE, PERSISTENCE, AND COSTS OF ACIDOSIS-RELATED ISSUES IN DAIRY COWS CONCERNING PARITY

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ABSTRACT

This study aimed to assess the occurrence, persistence, and cost implications of acidosis-related issues in dairy cows concerning parity, utilizing over 8 million test-day records of Holstein and Simmental breeds. The data analysis revealed that the analyzed issues in dairy cattle populations vary regarding the breed and parity. The Holsteins had a higher occurrence of acidosis compared to the Simmentals. Furthermore, Holsteins exhibited a more significant prevalence of acidosis in younger animals, while Simmentals demonstrated an increased incidence in older cows. The acidosis risk significantly reduced milk production in first-parity Holsteins, while older cows were more resilient. Among the Simmental breed, the effect of acidosis risk was limited to first-parity animals. The occurrence of acidosis in both breeds resulted in a significant and persistent reduction in milk production in older cows. Overall, results suggest the importance breed-specific management to minimize the occurrence of acidosis and maximize animal health and productivity.

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Introduction

Metabolic disorders can significantly affect dairy cattle health and productivity (Aitken, 2016). Some of the most common forms include hypocalcaemia (low levels of calcium in the blood), hypomagnesaemia (low levels of magnesium in the blood), and hypophosphataemia (low levels of phosphorus in the blood). Other types of metabolic disorders include fatty liver, in which excess fat accumulates in liver cells; ketosis, which occurs frequently during early lactation and may be associated with other problems such as fat cow syndrome, retained placenta, mastitis, metritis, and displaced abomasum; and ruminal acidosis, in which the pH of the rumen is abnormally low. Furthermore, acidosis represents one of the significant challenges affecting the dairy industry.

According to Antanaitis et al. (2019), acidosis has long-term health and economic consequences, making it a pressing issue in the dairy cattle production industry. Subacute ruminal acidosis (SARA) is a type of acidosis that occurs when there is impaired ruminal health, resulting in a depression of ruminal pH (Danscher et al., 2015). SARA is typically characterized by a ruminal pH that falls below 5.5-5.8 (Plaizier et al., 2008; Zebeli and Metzler-Zebeli, 2012; Danscher et al., 2015.), and it is caused by the consumption of diets high in readily fermentable carbohydrates and low in effective fiber such as grains. The consumption of these diets leads to the production of organic acids that exceed the buffering capacity of the rumen, leading to acidosis. As explained by Nagaraja and Titgemeyer (2007) and Golder et al. (2023), acidosis has severe implications for dairy cattle health and production, and its early detection is crucial for enabling sustainable business. According to Humer et al. (2017), the direct measurement of ruminal pH is the gold standard for SARA detection in cows. However, other indirect parameters, such as the observation of chewing and feeding activities, as well as the monitoring of milk, faecal, urine, and blood variables, can also be used to identify cows at risk. Furthermore, it is recommended to use more than one signal to reliably detect cows at risk of SARA. Given the significant farm costs caused by acidosis, early detection is crucial for enabling sustainable business and promoting animal welfare. Therefore, it is essential to implement effective management practices, such as monitoring feeding practices and rumen health, to prevent and manage acidosis in dairy cattle. Prompt recognition of the potential onset and avoidance of the development of a more severe disorder phase can be achieved through the use of existing data; that is test-day records. Test-day records include data on daily milk output, fat and protein content, and fat-to-protein ratio (F/P ratio). When compared to specific diagnostics, the use of such data is far less expensive and non-invasive (Eicher, 2004).

The prevalence and the effect of acidosis can vary depending on lactation stage and parity, breed, breeding region, etc. For instance, Gantner et al. (2016) reported the highest acidosis prevalence risk within the first 10 days of lactation, with the indication from 16 to 23 %, depending on parity. Similarly, Bramley et al. (2005) and O'Grady et al. (2008) found that between 10 and 15% of dairy cows grazing ryegrass-based pastures perennially have SARA. Golder et al. (2023) reported differences in acidosis

risk between regions, with Australia (37.2%) and California (39.2%) having similar prevalence of cows at a high risk of acidosis, whereas Canada had only 5.2%. Furthermore, Bramley et al. (2008); and Stauder et al. (2020) confirmed the effect of parity and stated that primiparous cattle usually have a higher risk of acidosis than multiparous cattle. The reason is that the primiparous cattle have had less exposure to high levels of energy-dense feeds (Humer et al., 2018). According to Penner et al. (2007) and Bramley et al. (2008), they may have fewer rumen papillae and a less-adapted rumen microbiome than older cows.

Since acidosis represents a frequent problem at dairy cattle farms, this study sought to investigate the occurrence, persistence, and cost implications of acidosis-related problems in Holstein and Simmental cows with respect to their age (parity).

Materials and methods

The research was carried out using the milk recording database of dairy cattle that were bred and under the selection in Croatia. The data was received from the Croatian Agency for Agriculture and Food (HAPIH). In Croatia, milk recording is performed using the alternative AT4/BT4 method, which requires measuring and sampling milk from each cow in production during morning or evening milking every four weeks. Milk samples are analysed at HAPIH's Central Laboratory for Milk Quality Control (SLKM) in order to detect the percentages of milk fat, protein, lactose, dry matter, dry matter without fat, urea, and freezing temperature. The chemical quality of milk is determined using infrared spectrophotometry by MilkoScan analyzers. Furthermore, the International Committee for Animal Recording (ICAR, 2017) has defined the procedure for taking milk samples during milk recording, as well as laboratory testing of samples. During the logical data control process, any test-day records outside the following ranges were eliminated from the database: daily milk yield below 3 kg or over 100 kg, daily milk fat content below 1.5% or over 9%, daily protein content below 1% or over 7%, and daily lactose content below 3% or over 6%. Moreover, test-day records with missing or illogical values for lactation stage (below 5 days or over 400 days), parity (below 1 or over 10), age at first calving (below 21 or over 36 months), calving date, milk recording date, and herd code were also removed from the database. Following the logical data control process, the database contained 4,922,751 test-day records for dairy Simmental cows and 3,953,637 test-day records of Holstein cows. These records were recorded between January 1st, 2005 and December 31st, 2022. The cows were classified into four groups depending on their parity: I., II., III., and IV. +. The herd was divided into five classes based on its size, ranging from less than 5 cows to 200 - 500. The test-day records were further divided into four different seasons based on the month of milk recording: winter (December, January, and February), spring (March, April, May), summer (June, July, August), and autumn (September, October, and November). The daily fat-to-protein ratio (F/P) was used to assess the risk of developing acidosis or acidosis occurrence (Eicher, 2004). F/P ratios < 1.1 indicated acidosis risk, while F/P < 1.1 in cows yielding 20 to 43 kg/day indicated the occurrence of subclinical acidosis.

The occurrence of acidosis risk or acidosis in the population of dairy cows refers to the percentage of cows with F/P < 1.1 (and daily milk yield of 20 to 43 kg/day), from the total number of animals. The occurrence was calculated separately for each parity class and breed. To analyse the effect of acidosis occurrence on daily production, only cows at acidosis risk/acidosis were included in the study. As the referent value, daily milk yield at the date of acidosis occurrence was taken. The acidosis index was determined based on the number of days after the acidosis detection, with D-0 being the test-day record on the day of detection, 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 the acidosis index on daily milk yield was analysed separately by parity class and breed using the following statistical model:

$$y_{ijklmno} = \mu + b_1\left(\frac{d_i}{305}\right) + b_2\left(\frac{d_i}{305}\right)^2 + b_3\, ln\left(\frac{305}{d_i}\right) + b_4\, ln^2\left(\frac{305}{d_i}\right) + A_j + P_k + S_l + H_m + M_{nm} + e_{ijklmno} \quad (1)$$

where:

Y_{ijklmn} = estimated daily milk yield;

μ = intercept;

b_1, b_2, b_3, b_4 = regression coefficients;

d_i = stage of lactation (i = 6 to 400 day);

A_j = fixed effect of age at first calving (j = 21 to 36 month) * only for firs parity;

P_k = fixed effect of parity k (k = I., II., III., IV. +);

S_l = fixed effect of season l (l = spring, summer, autumn, winter);

H_k = fixed effect of herd size k (k = I, II, III, IV, V, VI);

M_m = fixed effect of acidosis index m (m = D–0, A–1, A–2, A–3, A–4);

e_{ijklm} = residual.

The statistical significance of the differences between estimated LsMeans was tested by Scheffe's method of multiple comparisons in the MIXED procedure (SAS Institute Inc., 2019). The persistence and cost implications of acidosis were analysed in the four-month period after the acidosis occurrence. The monthly difference was equal to the product of the difference between the estimated daily milk yields at the successive milk recordings and the interval between those recordings. The total difference, in the analysed period, in milk yield (kg) and value (euro) was presented accordingly to parity and breed. The value of milk was calculated according to the current EU price of raw milk amounted 48.00 Eur/100 kg (EC, 2024).

Results

Analysed data on Holstein cows reveal that the likelihood of acidosis-related health issues varies depending on the parity of the animal. The occurrence of Holstein cows at risk of acidosis regarding the parity ranged from 30.26% in the oldest cows in the fourth and higher parities to 32.20% in animals in the second parity (figure 1). The highest occurrence of animals without risk of acidosis-related problems was observed in primiparous cows, with 56.87% being healthy. Furthermore, the occurrence of Holstein cows at acidosis regarding the parity is presented in Figure 2. The highest occurrence of healthy animals (72.89%), and the lowest occurrence of animals with acidosis (22.38%) was observed in the oldest animals (IV. +), while the highest occurrence of cows with acidosis was determined in Holstein cows in first lactation (27.03%). Observed indicates that the risk of developing acidosis in Holstein population decreases as the parity of the cow increases.

Figure 1. The occurrence of Holstein cows at risk of acidosis regarding the parity.

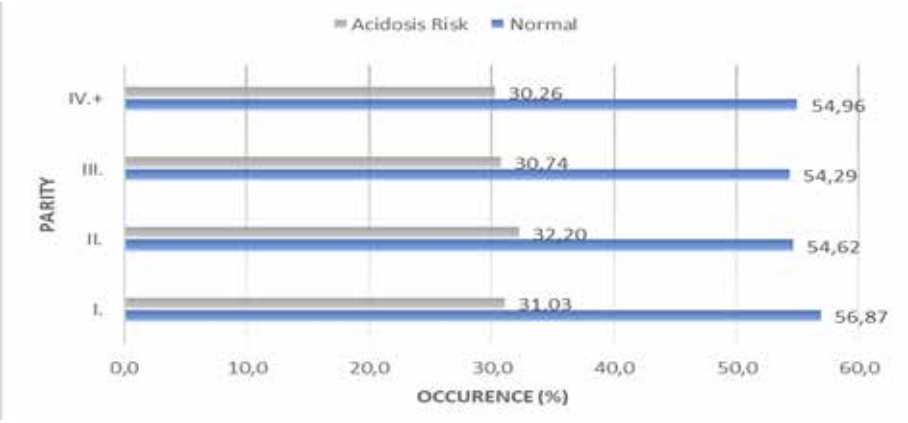
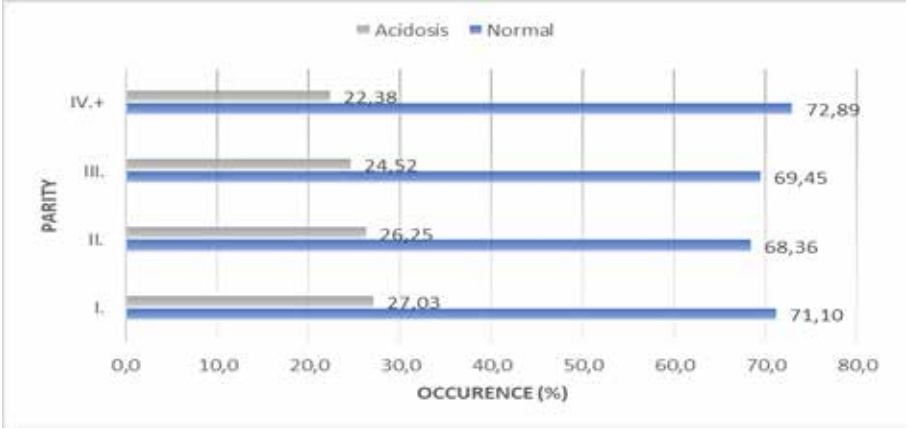


Figure 2. The occurrence of Holstein cows at acidosis regarding the parity.



The analysis of acidosis-related problems in the Simmental population is presented in Figures 3 and 4. The figures show that out of the total Simmental cow population, 30.35% of the animals were at risk of developing acidosis, with the highest risk found in cows in IV. + parities (32.44%) and the lowest risk in first parity cows at 26.92%. This indicates that the risk of developing acidosis increases as the parity of the cow increases. In terms of the occurrence of acidosis (Figure 4), the data shows that 87.12% of the Simmental cow population did not develop acidosis-related problems. However, acidosis was found to be most prevalent in cows in the third lactation at 14.10%, while those in the first lactation had the lowest occurrence of acidosis at 10.12%. This suggests that Simmental cows in their third lactation are more prone to developing acidosis than those in their first lactation. Overall, these findings demonstrate the importance of monitoring the occurrence of acidosis in Simmental cows, particularly in those in their later lactations, to ensure their health and productivity.

Figure 3. The occurrence of Simmental cows at risk of acidosis regarding the parity.

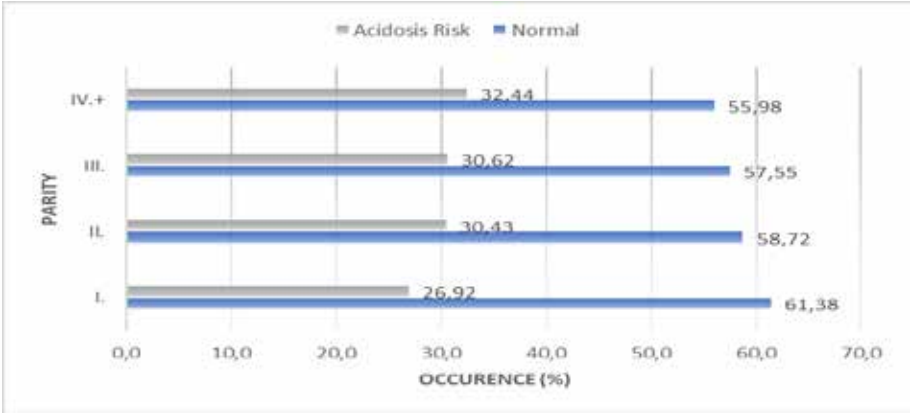
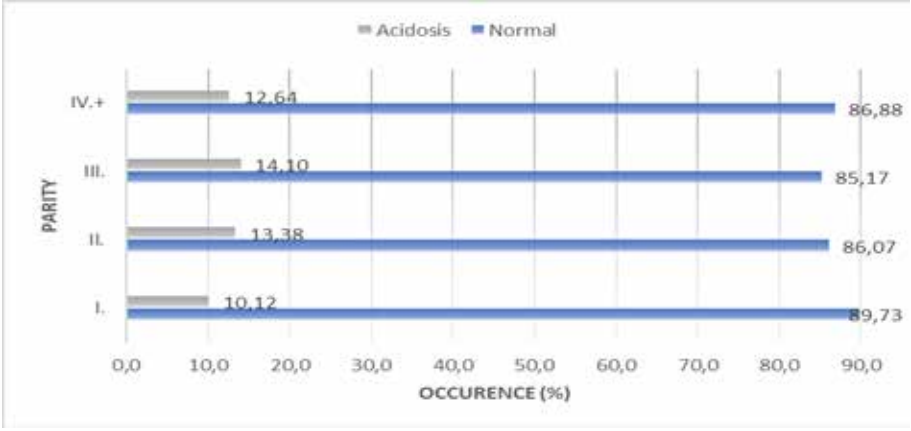


Figure 4. The occurrence of Simmental cows at acidosis regarding the parity



Furthermore, the analysis of the prevalence of acidosis-related issues in the dairy cow population revealed significant breed-related differences. Specifically, the Holstein population exhibited a higher incidence of acidosis than the Simmental breed, and the observed trend varied between the two breeds. In the case of Holstein cows, the occurrence was more pronounced in younger animals, while in Simmental cows, it was more frequent in older cows.

The statistical analysis confirmed that the risk of acidosis/acidosis significantly affected daily milk yield in both cattle breeds (Table 1). The LsMeans for daily milk yield in Holsteins at risk of acidosis varied from 23.52 kg/day on the day when the risk was determined (D-0) to 23.13 kg/day four months later (A-4) in the first parity animals; from 25.37 kg/day at A-2 to 25.04 kg/day at A-4 in the second parity; from 25.60 kg/day at A-1 to 24.43 kg/day at A-3 in the third parity; and from 24.25 kg/day at A-1 and A-2 to 23.88 kg/day at A-4 in the oldest animals (in fourth and higher parities). In Holstein cows in the first lactation during the entire analysed period of 4 months, the daily amount of milk continues to fall continuously after the risk of acidosis, while in cows in the second lactation, a decrease in the amount of milk is recorded at the first subsequent milk recording, while at the second one, there was an evident increase. Furthermore, in older cows (in the third, fourth and higher lactations) an increase in the amount of milk in the milk recordings after the risk of acidosis appeared. This indicates that the persistence of the effect of acidosis risk was most pronounced in primiparous, while older cows regenerate faster and return to productivity.

In Holstein cows in acidosis, the lowest daily milk yield, followed by an increase, was determined when acidosis occurred in the first parity cows (23.15 kg/day), while in older cows the lowest daily production occurred four months after the acidosis occurrence, with the continuous persistent decrease in cows in IV. + parity. This indicates that the persistence of the effect of acidosis occurrence was most pronounced in the oldest cows, while younger animals were able to restore their production potential faster. The established results indicate the opposite trend of the persistence of the effect of acidosis depending on, whether it is the risk of the occurrence or the occurrence of acidosis.

In cows of the Simmental breed, the daily amount of milk after the established risk of developing acidosis was higher at the first subsequent milk recording (17.12 vs 17.20 kg/day; 17.94 vs. 18.13 kg/day; 18.50 vs. 18.83 kg/day; 17.19 vs. 17.43 kg/day in animals in I., II., III., or IV. + parity), while at the next recording, there was mostly an insignificant decrease in production (Table 1). Furthermore, in Simmental breeds, a continuous drop in milk production after the occurrence of acidosis was evident in all parties. Obtained implicate significant and persistent negative effects of acidosis occurrence on milk production of dairy Simmental cows regardless of the animals age (parity).

Table 1. LsMeans of daily milk yields at and after the milk recording when acidosis risk/ acidosis occurred in accordance with the parity and breed

Parity	MR	Holstein				Simmental			
		Acidosis risk		Acidosis		Acidosis risk		Acidosis	
		Estim	StdEr	Estim	StdEr	Estim	StdEr	Estim	StdEr
I.	D-0	23.52	0.07	23.15	0.05	17.12	0.04	21.77	0.04
	A-1	23.32	0.07	23.26	0.05	17.20	0.04	19.88	0.04
	A-2	23.41	0.07	23.87	0.05	17.21	0.04	19.95	0.04
	A-3	23.18	0.07	24.15	0.05	17.09	0.04	19.65	0.04
	A-4	23.13	0.06	24.95	0.05	17.05	0.04	19.83	0.04
II.	D-0	25.31	0.05	27.61	0.05	17.94	0.05	22.48	0.05
	A-1	25.28	0.05	28.02	0.04	18.13	0.05	20.96	0.05
	A-2	25.37	0.05	27.28	0.04	18.12	0.05	20.80	0.05
	A-3	25.16	0.05	26.44	0.04	18.05	0.05	20.51	0.05
	A-4	25.04	0.05	25.28	0.04	17.98	0.05	20.52	0.05
III.	D-0	25.44	0.06	28.10	0.05	18.50	0.06	22.99	0.05
	A-1	25.60	0.06	28.49	0.05	18.83	0.06	21.58	0.05
	A-2	25.56	0.06	27.61	0.05	18.80	0.06	21.43	0.05
	A-3	24.43	0.06	26.66	0.04	18.72	0.06	21.08	0.05
	A-4	25.21	0.05	25.26	0.04	18.67	0.06	21.07	0.05
IV. +	D-0	24.07	0.06	27.41	0.06	17.19	0.04	22.32	0.05
	A-1	24.25	0.06	27.28	0.06	17.43	0.04	20.55	0.05
	A-2	24.25	0.06	26.40	0.05	17.40	0.04	20.42	0.05
	A-3	24.06	0.06	25.51	0.05	17.36	0.04	20.06	0.05
	A-4	23.88	0.05	24.33	0.05	17.33	0.04	20.01	0.05

*MR – milk recording; D-0 – milk recording when the acidosis prevalence was determined; A-1, A-2, A-3, A-4 – successive milk recordings; Estim – estimate; StdEr – standard error of estimate.

Source: Authors' calculations

Monthly and total differences in milk production (the amount and the value in Eur) after the occurrence of acidosis risk in accordance with the parity and breed are presented in Table 2. The occurrence of acidosis risk has been observed to result in a significant decrease in milk production in Holstein cows, particularly in first parity animals. The highest reduction in milk production was noticed in these cows, amounting to a total of 11.86 kg of milk or 5.69 euros. On the other hand, the lowest cost of acidosis risk occurrence was observed in the oldest Holstein cows, with a loss of only 2.82 euros (5.87 kg of milk). In the Simmental breed, the impact of acidosis risk on milk production was limited to animals in their first parity. The older cows were able to continue with milk production without any significant losses. This suggests that the consequences of acidosis risk may vary depending on the breed of cow and their parity.

Table 2. Estimated monthly and total differences in quantity and value of milk after the occurrence of acidosis risk in accordance with the parity and breed

Parity	Month 1		Month 2		Month 3		Month 4		Total difference	
	kg	euro	kg	euro	kg	euro	kg	euro	kg	euro
Holstein										
I.	-5.92	-2.84	2.45	1.18	-6.74	-3.24	-1.66	-0.80	-11.86	-5.69
II.	-0.81	-0.39	2.56	1.23	-6.31	-3.03	-3.54	-1.70	-8.10	-3.89
III.	4.57	2.19	-0.95	-0.46	-3.86	-1.85	-6.84	-3.28	-7.08	-3.40
IV. +	5.43	2.61	-0.01	0.00	-5.83	-2.80	-5.46	-2.62	-5.87	-2.82
Simmental										
I.	2.33	1.12	0.40	0.19	-3.59	-1.72	-1.31	-0.63	-2.18	-1.05
II.	5.63	2.70	-0.25	-0.12	-2.15	-1.03	-1.92	-0.92	1.30	0.62
III.	10.01	4.80	-1.09	-0.52	-2.33	-1.12	-1.41	-0.68	5.18	2.49
IV. +	7.24	3.48	-0.96	-0.46	-1.17	-0.56	-1.00	-0.48	4.12	1.98

Source: Authors' calculations

Monthly and total differences in milk production (the amount and the value in Eur) after the occurrence of risk in accordance with the parity and breed are presented in Table 3. The occurrence of acidosis in the Holstein population has led to a considerable reduction in milk production, particularly in older cows. The oldest cows experienced the highest losses in milk production, which amounted to 92.36 kg of milk and a value of 44.33 euros. Furthermore, while other cows showed a period of increased production in the first month following the acidosis occurrence, cows in IV. + parities had a continuous and persistent decline in milk production throughout the testing period. On the other hand, the youngest cows experienced a consistent increase in milk production, resulting in a total increase of 53.97 kg of milk, which is valued at 25.91 euros. The effects of acidosis were also observed in the Simmental breed, where the highest losses were also determined in the oldest cows, accounting for a reduction of 69.30 kg of milk. Similarly, younger Simmental cows were also affected by acidosis, resulting in a loss of around 58 kg of milk, valued at 28 euros.

Table 3. Estimated monthly and total differences in quantity and value of milk after the occurrence of acidosis in accordance with the parity and breed

Parity	Month 1		Month 2		Month 3		Month 4		Total difference	
	kg	euro	kg	euro	kg	euro	kg	euro	kg	euro
	Holstein									
I.	3.14	1.51	18.27	8.77	8.48	4.07	24.08	11.56	53.97	25.91
II.	12.31	5.91	-22.15	-10.63	-25.23	-12.11	-34.86	-16.73	-69.93	-33.57
III.	11.71	5.62	-26.53	-12.73	-28.53	-13.69	-41.79	-20.06	-85.14	-40.87
IV. +	-3.81	-1.83	-26.23	-12.59	-26.88	-12.90	-35.45	-17.02	-92.36	-44.33
	Simmental									
I.	-56.81	-27.27	2.17	1.04	-8.94	-4.29	5.32	2.55	-58.27	-27.97
II.	-45.36	-21.77	-4.83	-2.32	-8.85	-4.25	0.46	0.22	-58.58	-28.12
III.	-42.45	-20.38	-4.41	-2.12	-10.31	-4.95	-0.50	-0.24	-57.67	-27.68
IV. +	-53.22	-25.55	-3.79	-1.82	-10.98	-5.27	-1.32	-0.63	-69.30	-33.26

Source: Authors' calculations

Overall, it can be pointed out that the occurrence of acidosis has had a significant effect on milk production in both Holstein and Simmental cows, with the oldest cows being the most affected.

Discussions

Data analysis on Holstein and Simmental cows was conducted to determine the likelihood of acidosis-related health problems based on the cow's parity. The results showed that the risk of acidosis and acidosis occurrence varied depending on the age of the animal. For Holstein cows, the risk of acidosis was highest in the second parity (32.20%) and lowest in the oldest cows (IV. +) with 30.26%. The highest occurrence of cows with acidosis was noted in the first lactation (27.03%), while the lowest occurrence was in the oldest animals (IV. +; 22.38%). This suggests that the risk of developing acidosis in Holstein cows decreases with the age (parity) of the animal. For Simmental cows, the highest risk of acidosis was found in the oldest cows (IV. +) (32.44%), while the lowest risk was found in first parity cows (26.92%). The cows in third lactation had the highest occurrence of acidosis (14.10%), while the first lactation animals had the lowest occurrence (10.12%). This indicates that the risk of developing acidosis in Simmental cows increases as the parity of the cow increases. Furthermore, the analysis of the prevalence of acidosis-related issues in the dairy cow population revealed significant breed-related differences. Specifically, the Holstein population exhibited a higher incidence of acidosis than the Simmental breed, and the observed trend varied between the two breeds. In the case of Holstein cows, the occurrence was more pronounced in younger animals, while in Simmental cows, it was more frequent in older cows.

Several studies have confirmed the impact of parity on the prevalence of acidosis in dairy cattle (Penner et al., 2007; Bramley et al., 2008; Gantner et al., 2016; Humer et al., 2018; and Stauder et al., 2020). In particular, the studies by Bramley et al. (2008) and Stauder et al. (2020) have analyzed the effect of parity and have found that primiparous cattle are more susceptible to acidosis than multiparous cattle. This is because primiparous cattle have had less exposure to high levels of energy-dense feeds, as noted by Humer et al. (2018). Additionally, Penner et al. (2007) and Bramley et al. (2008) have suggested that younger cows may have fewer rumen papillae and a less-adapted rumen microbiome than older cows, which may further contribute to their increased risk of acidosis. On the other hand, Atkinson (2014) in the analysis of dairy cattle in UK, defined the rumen pH $\leq$5.5 as the indication of SARA and reported that there was no relationship between rumen pH and days in milk or parity.

The performed analysis confirmed that the risk of acidosis/acidosis significantly affected daily milk yield in both cattle breeds. In the first lactation of Holstein cows, milk production decreased steadily for four months after the risk of acidosis. For cows in the second lactation, milk production decreased only at the first milk recording, but increased at the second. In cows that had calved three or more times, milk production increased after the risk of acidosis. This indicates that the effect of acidosis risk was

strongest in cows calved for the first time, while older cows recovered more quickly and returned to productivity. Reaction to acidosis occurrence in Holstein population differed regarding the animal's age (parity). Younger cows (from I. to III. parity) with acidosis tend to experience an increase in daily milk yield after the acidosis occurrence. This increase was most pronounced in first-party cows. Older cows, on the other hand, experience the lowest daily production four months after the onset of acidosis. The continuous decrease in cows in IV. + parity suggests that the effect of acidosis occurrence was most persistent in older cows, while younger cows were able to recover their production potential faster. The results indicate that the effect of acidosis-related issues persists differently depending on whether it is the risk of occurrence or the occurrence itself. In Simmental cows, the daily milk production tends to increase after acidosis risk, while after the occurrence of acidosis a continuous drop in milk production was evident in all parities. Obtained findings demonstrate the potential long-term persistent effects of acidosis on dairy Simmental cows, which can lead to reduced milk production and have economic implications for farmers.

Abdela (2016) reported that the Sub Acute Ruminal Acidosis (SARA) is a complex condition that has far-reaching consequences in dairy cattle herds. It can lead to decreased feed intake, fluctuations in feed intake, lower diet digestibility, reduced milk yield, decreased milk fat percentage, gastrointestinal damage, liver abscesses, and lameness. These effects can increase the cost of veterinary care and cause losses due to reduced milk production. Furthermore, Abdela (2016) highlighted that overfeeding grain to dairy cows can temporarily boost milk production but can cause SARA to persist as a significant problem. Therefore, according to Abdela (2016), it is crucial to monitor the cattle regularly to spot the signs of SARA early and limit the economic losses associated with the condition. According to a study conducted by Krause and Oetzel (2005), the financial losses resulting from SARA are significant and can be attributed to various factors such as decreased milk production, decreased efficiency of milk production, premature culling, and increased death loss. Another study conducted by Stone (1999) on a large dairy farm in New York State revealed that SARA can lead to a reduction in milk yield by 2.7 kg/day, milk fat production by 0.3%, and milk protein production by 0.12%. These findings highlight the detrimental effects of SARA on dairy production and emphasize the need for effective prevention and management strategies to mitigate its impact.

As determined in this research, the occurrence of acidosis risk leads to a significant decrease in milk production in Holstein cows, particularly in first-parity animals. The highest reduction in milk production was noticed in these cows, amounting to a total of 11.86 kg of milk or 5.69 euros. In contrast, the oldest Holstein cows were found to be more resilient, with a loss of only 2.82 euros (5.87 kg of milk) in case of acidosis risk. In the Simmental breed, the impact of acidosis risk on milk production was limited to animals in their first parity. The older cows were able to continue with milk production without any significant losses. Furthermore, the occurrence of acidosis in Holstein cattle has resulted in a significant reduction in milk production, especially in older cows. The

highest decrease in milk production was observed in the oldest cows, which amounted to 92.36 kg of milk and a value of 44.33 euros per animal. Cows in IV. + parities showed a continuous and persistent decline in milk production throughout the testing period, while other cows showed a period of increased production in the first month following the acidosis occurrence. Conversely, the youngest cows experienced a consistent increase in milk production, resulting in a total increase of 53.97 kg of milk, worth 25.91 euros per animal. The effects of acidosis were also observed in the Simmental breed, where the highest losses were also determined in the oldest cows, accounting for a reduction of 69.30 kg of milk. In addition, younger Simmental cows were also affected by acidosis, resulting in a loss of around 58 kg of milk, valued at 28 euros.

Several research studies have examined the economic implications of acidosis on dairy farms. Decreased milk production, reduced efficiency of milk production, premature culling, and increased death loss are all considered to be the major reasons for financial losses caused by acidosis occurrence (Krause and Oetzel, 2005). Stone (1999) estimated the economic impact of SARA amounted to $400 - $475 lost income per cow/year due to SARA occurrence. Cha et al. (2010) evaluated the costs of acidosis consequences and determined that the sole ulcers, a common consequence of SARA due to laminitis lesions, cost producers $216 per case, with 38% of the costs being due to losses in milk production. Finally, Donovan (1997) estimated that the costs of SARA occurrence in the US dairy industry amounted between $500 million to $1 billion annually.

Conclusions

The results obtained from this study indicate that the prevalence, persistence, and costs of acidosis-related issues in dairy cattle populations vary with respect to the animal's breed and age (parity). The study revealed that the Holstein population had a higher incidence of acidosis when compared to the Simmental breed. Furthermore, the trend of occurrence varied between the two breeds, with Holstein cows exhibiting a more significant prevalence of acidosis in younger animals, while Simmental cows demonstrated an increased incidence in older cows.

Additionally, the study showed that acidosis risk significantly reduced milk production in Holstein cows, particularly in first-parity animals. In contrast, the oldest Holstein cows were found to be more resilient, with lesser losses. Among the Simmental breed, the effect of acidosis risk on milk production was limited to animals in their first parity, while older cows were able to continue with milk production without any significant losses. Moreover, the occurrence of acidosis in Holstein cattle resulted in a significant reduction in milk production, especially in older cows. In the Simmental breed, the highest losses were also determined in the oldest cows.

In light of these findings, it is important to implement breed-specific management practices to minimize the occurrence of acidosis and maximize animal health and productivity.

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Conflict of interests

The authors declare no conflict of interest.

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