PHYSIOLOGICAL STATE OF DAIRY CATTLE AND SOMATIC CELLS COUNT CLASS VERSUS LEVEL OF PLASMA MALONYLODIALDEHYDE

STAN FIZJOLOGICZNY KRÓW ORAZ LICZBA KOMÓREK SOMATYCZNYCH W MLEKU A POZIOM MALONYLODIALDEHYDU W OSOCZU KRWI

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ABSTRACT

The research involved 80 cows being in 2 physiological states: near the end of lactation (approximately 2 months before delivery) (N=40), and one month after calving. In plasma was established MDA level (malonylodialdehyde) and in milk SCC (Somatic Cells Count).

The MDA level in plasma in groups of calved and non-calved cows remained at a similar level. It was found that a statistically significant MDA level ($p \leq 0,05$) was present in milk from non-calved cows – with somatic cells count below 400,000 per ml during test milking, as compared to cows producing milk with somatic cells count of over 400,000 per ml.

Key words: MDA / physiological state / SCC/ dairy cattle

STRESZCZENIE

Badaniami objęto 80 krów w dwóch stanach fizjologicznych: około 2 miesiące przed porodem i miesiąc po wycieleniu. W osoczu krwi krów oznaczono poziom malonylodialdehydu (MDA) a w mleku dojonych krów- liczbę komórek somatycznych (LKS).

Nie odnotowano istotnej statystycznie różnicy w poziomie MDA między grupami krów w odmiennych stanach fizjologicznych. Natomiast stwierdzono, że krowy nie wycielone, o liczbie komórek somatycznych w mleku powyżej 400 tys./ml, średnio charakteryzował niższy poziom MDA w osoczu w stosunku do krów o liczbie komórek somatycznych w mleku poniżej 400 tys./ml włącznie, przy czym różnica ta była istotna statystycznie ($p \leq 0.05$).

SŁOWA KLUCZOWE: MDA / stan fizjologiczny / liczba komórek somatycznych / bydło mleczne

DETAILED ABSTRACT

Badaniami objęto 80 krów z obory należącej do RZD UTP z terenu województwa kujawsko-pomorskiego. Produkcyjność mleczna krów z badanej obory pozostawała na poziomie zbliżonym do średniej w kraju [10]. Krowy utrzymywane były w systemie alkierzowym i żywione były zgodnie z systemem TMR. Dane, dotyczące dojów próbnych uzyskano z bazy danych SYMLEK. Badane krowy były w 2 stanach fizjologicznych: 2 miesiące przed wycieleniem (N=40) i miesiąc po wycieleniu (N=40). Krew do badań pobierano dzień po kontroli jakości mleka. W osoczu krwi oznaczono poziom malonylodialdechydu (MDA) metodą Buege i Austa [3]. Istotność różnic oznaczono przy użuciu hierarchicznej analizy wariancji na danych poddanych transformacji (-Log2 (MDA)).

Poziom MDA w osoczu krów wycielonych i nie wycielonych pozostawał na zbliżonym poziomie, przy wyższej zmienności w grupie krów nie wycielonych. Różnice między grupami były nie istotne statystycznie (tab.1, Rys.1).

Stwierdzono znacząco wyższy poziom MDA w mleku krów nie wycielonych i z niską zawartość komórek somatycznych w mleku z próbnych dojów (LKS poniżej 400 tys./ml) w stosunku do krów nie wycielonych, produkujących mleko o zawartości komórek somatycznych powyżej 400 tys./ml. W grupie o najwyższym średnim poziomie MDA odnotowano również największą zmienność w zakresie tej cechy (Vx=104%). Takie zróżnicowanie wynikać może z wpływu lub interakcji z innymi czynnikami – wzrost MDA odnotowuje się zarówno podczas zmian chorobowych w organizmie, czy podczas dużego stresu, ale również podczas procesu zdrowienia.

INTRODUCTION

Milk cows, due to high intensity of metabolic processes, frequently suffer from body homeostasis disorders [1, 9]. One of the symptoms indicating metabolic stress is oxidation stress – a condition where in a cell the biochemical balance between the number of the so-called reactive oxygen species (RFT) produced and anti-oxidation systems performance is upset. The biochemical outcome of free radicals transformation is an increase in lipid peroxidation outcome (LPO), in particular of malonylodialdehyde (MDA).

It is believed that a prolonged oxidation leads to reduced immunity of the body, and eventually to changes at cell level, including damage to nucleic acids. The reactive oxygen species also participate in the body's defensive processes, therefore their increased level in the course of inflammations [7].

The objective of the research was an attempt to determine the connection between the MDA level in plasma and the physiological condition of cows, as well as between the MDA level and the somatic cells count (SCC).

MATERIAL AND METHODS

The research covered 80 cows in two physiological states: near the end of lactation (approximately 2 months before delivery) (N=40) and one month after calving (N=40). Blood for examination was taken the day after test milking, in the morning, prior to feedstuff application. The animals were kept in a cowshed belonging to the Farming Research Institute, University of Technology and Life Sciences, indoor fed by means of the TMR method. MDA level in plasma expressed in nm/ml (malonylodialdehyde) was established with the use of Buege and Aust [3].

Table 1 Statistical characteristics of MDA level [nm/ml] in plasma of cows depending on their physiological condition and SCC in test milking

Tabela 1. Charakterystyka statystyczna poziomu MDA [nm/ml] w osoczu krwi krów w zależności od stanu fizjologicznego oraz liczby komórek somatycznych w próbnych dojach.

	Calved wycielone		not-calved nie wycielone	
	SCC ≤ 400,000	SCC > 400,000	SCC ≤ 400,000	SCC > 400,000
N	23	17	28	12
Average ± SE Średnia ± SE	**0.1362 ± 0.014**	**0.144 ± 0.027**	**0.173 ± 0.034**	**0.091± 0.024**
Vx	51.5%	77.2%	104%	92.2%
Average (-Log2 (MDA)) Średnia (-Log2 (MDA))	**3.11**	**3.20**	**3.00[a]**	**4.04[a]**

a,a – statistically significant differences with p≤0.05

a,a – różnice istotne statystycznie na poziomie p≤0,05

The statistical analysis was carried out by means of hierarchical analysis of variance. Compatibility with the normal spread was tested with the use of Kolmogorov-Smirnov test with improvement by Lilliefors, and variance homogeneity in groups with the Levene test. Owing to no normal spread of the analysed variable, logarithmic transformation was carried out according to the formula of (-Log2 (MDA)). Calculations were made using the SAS package [8].

RESULTS AND DISCUSSION

MDA level in plasma in the group of calved cows and non-calved cows remained at a similar level, with a higher variability in the group of non-calved cows. Differences between the groups of diverse physiological conditions were statistically negligible.

It was found that a higher MDA level (0.173 nm/ml) occurred in plasma of non-calved cows with somatic cells count below 400,000 per ml in the course of test milking in comparison to cows producing milk with somatic cells count exceeding 400,000 per ml (0.91 nm/ml) (Table 1, Fig. 1). Among the group with the highest average MDA level, the highest variability in terms of this trait was also noted (Vx=104%).

Following a statistical analysis on transformed MDA levels, statistically significant differences were revealed between the level of (-Log2 (MDA)) in the group of non-calved cows with a low somatic cells count (SCC below 400,000 per ml) in the course of test milking as compared to cows producing milk with somatic cells count exceeding 400,000 per ml (Table 2). The difference between the groups was statistically significant, and at the level of $p \leq 0.05$.

Considerable variability of MDA level in the cow group with high number of SCC (Table 1), evidencing its heterogeneity, may be a result of both the influence or interaction with other factors – MDA increase is noted both while a body is undergoing pathological changes or considerable stress but also during a healing process. Low MDA level in plasma of this group may indicate reduced immunity.

Miller et al [7], researching the influence of active oxygen forms on frequent cow diseases, including mastitis, found that these are accompanied by oxidation stress. When in a cow's body homeostatic balance is upset, for instance, by high milk production, one of the consequences is oxidation stress, which has direct or indirect impact on animals' health [7]. Diseases, and in particular the accompanying inflammation, disturb cell oxidization, and this in turn leads to intensive production of free oxygen radicals type 0_2, H_20_2, OH, which damage tissues. Oxidation stress is responsible for "overuse" of physiological antioxidant resources, and insufficiency of immune mechanism. This may be counteracted by adding vitamin E and selenium (antioxidants) to ruminants' diet, which decreases incidence of cows, including mastitis incidence rate [6]. Bernabucci et al [2] have indicated the connection between ambient temperature and occurrence

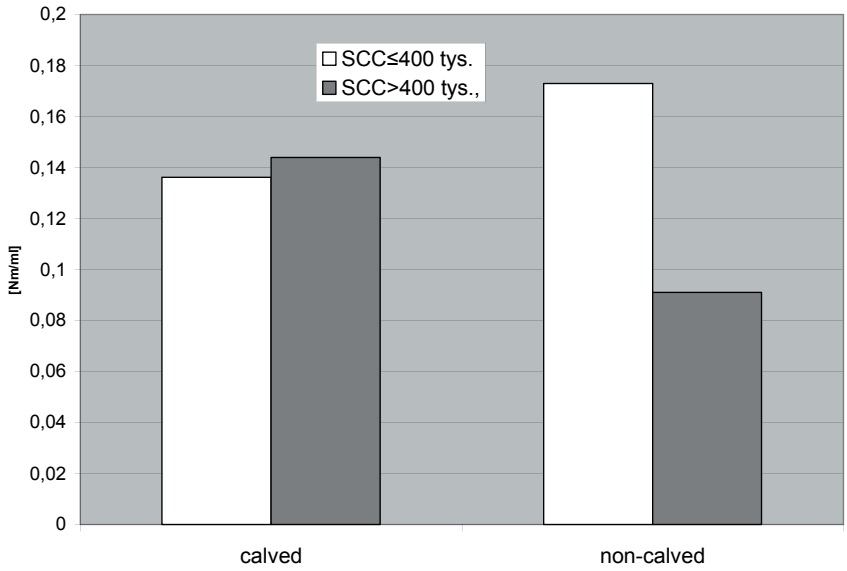

Fig. 1. MDA level [nm/ml] in plasma of cows depending on their physiological status and SCC in test milking

Rys. 1. Poziom MDA [nm/ml] w osoczu krwi krów w zależności od stanu fizjologicznego oraz liczby komórek somatycznych w próbnych dojach.

of oxidation stress in milk cows, and consequently with the change of MDA level in plasma. Castillo et al [4, 5] examined oxidation status (MDA and TAS – Total Antioxidant Status) in the case of advanced pregnancy, and at the beginning of lactation. They proved existence of a relationship between MDA and TAS and animals' physical condition. The same authors noted considerable individual variability between animals in groups, caused, according to the authors, by factors not taken into consideration in the experiment.

CONCLUSION

Achieved results of own research indicate statistically significant differences between the MDA level in cows with high and low level of somatic cells ($p \leq 0.05$). However, this requires further research conducted for a longer period on a larger animal population.

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