The zinc (Zn) content of milk from high-yielding cows depending on their age and lactation day

Zawartość cynku (Zn) w mleku krów wysoko wydajnych w zależności od ich wieku i dnia laktacji

Anna Nogalska[1], Martyna Momot[2], Monika Sobczuk-Szul[2], Paulina Pogorzelska-Przybyłek[2], Zenon Nogalski[2]

[1]Department of Agricultural Chemistry and Environmental Protection, [2]Department of Cattle Breeding and Milk Quality Evaluation, University of Warmia and Mazury in Olsztyn, Poland
e-mail: anna.nogalska@uwm.edu.pl

Milk is a rich source of dietary minerals, including macronutrients and micronutrients, which play an important role in human nutrition. A glass of cow's milk (250 ml) contains 300 mg Ca, 250 mg P, 381 mg K, 125 mg Na, 32 mg Mg, 0.90 mg Zn and 0.06 mg Fe on average. The chemical composition of milk varies depending on a variety of genetic (cattle breed), environmental (diet, season) and physiological (lactation phase, udder health) factors.

The aim of this study was to determine the effect of age of high-yielding cows and lactation day on the zinc (Zn) content of milk. The experimental materials comprised 55 Polish Holstein-Friesian (PHF) cows from two different herds kept in the Region of Warmia and Mazury (NE Poland). A total of 1021 milk samples were collected from cows in their first (18 animals), second (20 animals) and third (17 animals) lactation. Feeding regimes, cow productivity and the quality of genetic material were comparable in both farms. All animals were kept in free-stall barns. Cows with similar expected calving date were selected for the study to eliminate the effect of season.

Milk samples were subjected to wet mineralization in a microwave oven in the presence of a mixture of nitric acid and hydrochloric acid, in accordance with the relevant standards. The Zn content of mineralized milk samples was determined by atomic absorption spectrometry (AAS). The results were analyzed statistically by one-way ANOVA for non-orthogonal designs, with the use of Statistica 10.0 software. The significance of differences between means was estimated by Tukey's range test at $P < 0.05$ and $P < 0.01$.

The age of high-yielding PHF cows influenced milk production. The average milk yield increased significantly with successive lactations (I – 10279 kg, II – 11020 kg, III – 12186 kg). The average Zn content of milk reached 4.49 mg·dm^{-3} and it remained within normal limits of 2 to 5 mg·dm^{-3}. The age of cows had no significant effect on Zn concentrations in milk, but a rising tendency was observed in successive lactations. The highest Zn content of milk (4.59 mg·dm^{-3}) was noted in the oldest animals (lactation III). The milk of cows in their third lactation was characterized by high Zn concentrations (5.0–6.5 mg·dm^{-3}) until day 40 post partum, whereas in the first and second lactation Zn levels in milk decreased already on days 20–25. After the peak daily yield, noted on days 42–55, the Zn content of milk stabilized at 4.0–4.4 mg·dm^{-3} and remained stable until the end of lactation.

Conclusions

1. The milk performance of PHF cows increased significantly in three consecutive lactations.
2. The age of cows had no significant effect on the average Zn content of milk throughout lactation.
3. In the first phase of lactation, high Zn concentrations in milk were observed for the longest period of time in the oldest cows. In the second month after calving, the Zn content of milk stabilized at a normal level and remained stable until the end of lactation.