COMPARISON OF TMR AND PMR FEEDING SYSTEMS

Stanislaw Winnicki[1], Romana Głowicka-Woloszyn[2], Tomasz Kolodziejczyk[1], Waclaw Romaniuk[1], Robert Kantarowski[2]
[1]Poznan Branch of the Institute of Technology and Life Sciences in Falenty
[2]Poznan University of Life Sciences
romana.glovicka@wp.pl

Abstract. The paper analyzes the effectiveness of TMR and PMR feeding systems. A single 65 cows herd was kept in a free-standing milk house and fed the TMR mix. The cows of daily yield above 20 kg received 2 kg of PMR feed per 5 kg of milk yield. The study was conducted over four months. The feed consisted of corn and hay silage. During September and October of 2009 (the fall period) the feed was augmented with fresh grass and during November and December (the winter period) with larger amounts of hay silage. The basic feeding ration was set for the milk yield of 20 kg. The average daily yield of the herd varied between 26 and 28.5 kg, while the individual yield – between 8 and 55 kg. Once a month each individual feeding ration was examined for sufficient energy and protein content. This analysis used milk urea and protein content as indicators. Twenty five percent of the herd had yield below 20 kg and this was the TMR group. It showed the balanced energy and protein levels in only 15 % cows during the fall and 40 % during winter. Insufficient protein level affected 50 % and only 8 % over the fall and winter periods, respectively. Energy deficiency was similar in fall and in winter and concerned 33 % of the group. The cows of high yield (over 20 kg, 75 % of the herd, the PMR group) showed balanced energy and protein levels among 30 % of the group in both feeding periods. Protein deficiency was observed in 35 % of the group during fall and in 14 % during winter. Energy deficiency showed among 15 % of the group in the fall and among 33 % during the winter period. Lower yield cows benefited more from the winter feeding. Higher yields, too, benefited more from the winter feeding, but only with respect to protein levels. Energy-wise the high yielding cows were better off in the fall.

Key words: feeding systems, TMR, PMR.

Introduction

Feeding is the primary factor that affects milk productivity and, consequently, the production profitability. The feeding value of the fodder depends on its nutritious content and the ration volume adjusted according to the individual yield. The values of various diets are determined under lab conditions; in production, the feeding rations are gauged by milk volume, its chemical composition, and the health condition of the cows.

With freestall housing systems it is difficult to determine the optimal feeding due to considerable variation of productivity between individual cows. Splitting into technological groups of similar productivity will resolve the problem for larger herds, but for smaller ones the solution is not feasible.

Increasing the productivity calls for more nutritious diets including energy-dense concentrate feeds [1]. Up to recently concentrates had been administered separately, but one time intake of larger amounts of nutrient-dense rations was proven to cause digestive disorders leading to acetonemia (ketosis), a serious metabolic disease [2-4]. To prevent it, concentrates were mixed with pasture forage of easily degradable protein to produce TMR (Total Mixed Ration). For herds of high productivity variation a system known as PMR (Partial Mixed Ration) was applied. Here, the whole herd is fed rations calculated from the average milk yield, while cows of higher yield get additional concentrates from the feeding station dispensed in small dosages throughout the day.

The aim of the study was to determine: adequacy of energy and protein intakes in groups fed TMR and PMR; the effect of green forage supplement in the fall period on dietary energy and protein balance.

Materials and methods

The research was conducted for a single group 65 cows herd. The animals were housed year round in a freestall no bedding system and milked in a herringbone parlor. Adequate energy and protein provisions in the diet were analyzed in two two-month feeding periods: fall and winter. The composition of the basic ration per animal is shown in Table 1.

The basic feeding ration was set for the milk yield of 20 kg. The cows of higher yield received concentrates from the feeding station. The protein and urea content in the milk was used to measure

the energy and protein balance. Adequate energy intake was indicated by the milk protein level ranging from 3.2 to 3.6 %, while the optimal protein supply by the urea level between 150 $mg \cdot l^{-1}$ and 300 $mg \cdot l^{-1}$.

The study input data came from the proceedings of milk utility control conducted by the AT4 method.

Table 1

The composition of the basic ration

Feeding period	TMR per animal, kg			Green forage, kg
	corn silage	haylage	protein concentrate	
Winter	25	20	2	-
Fall	20	10	2	20

Results and discussion

The average daily yield of the cows fed PMR was almost twice the yield of the cows fed TMR (Table 2) in both study periods. The highest yields of the PMR fed cows reached 55 kg in the fall and 52 kg in winter; The TMR fed cows yielded only 19 and 20 kg, respectively. Also, the TMR group showed a slightly smaller daily yield variation.

Table 2

Characteristics of daily milk yield in the fall and winter for PMR and TMR fed cows

Study period	Descriptive statistics	Daily yield, kg	
		PMR	TMR
fall	avg. ± stand. dev	32.3±6.7	16.3±2.4
	minimum	21.2	8.0
	maximum	54.8	19.2
winter	avg. ± stand. dev	30.1±7.5	16.0±3.3
	minimum	20.4	10.8
	maximum	52.0	20.0

The average milk protein content in the PMR group, indicative of optimal energy intakes, was in both periods smaller than in the TMR group (Figure 1). The t-test proved the differences statistically significant ($p<0.01$). Furthermore, lower levels of milk protein were observed during fall than during winter in both PMR and TMR groups.

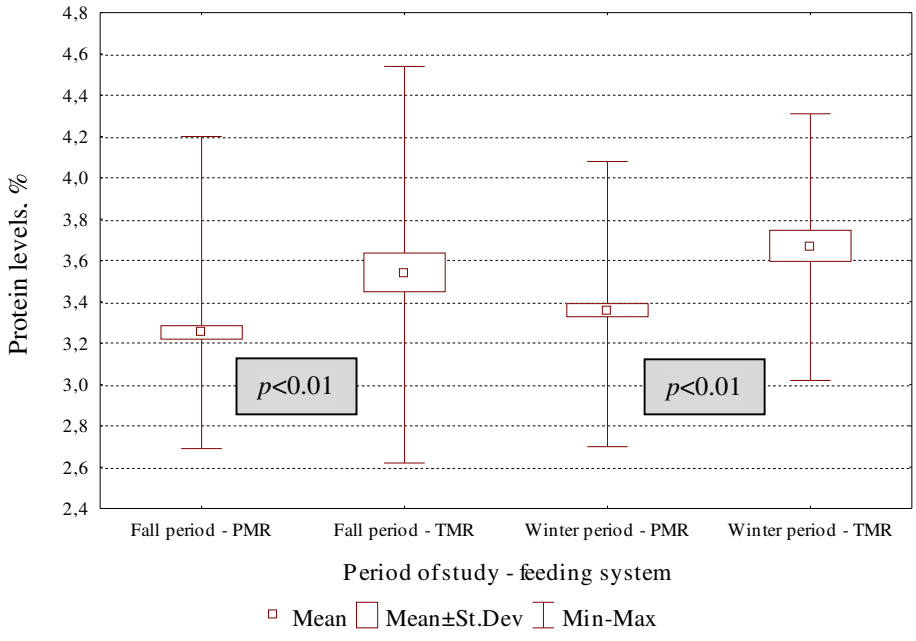

Fig. 1. **Characteristics of milk protein content**

Optimal energy intake in the PMR group benefited 41 % of animals in both periods, but in the winter the percentage that suffered from excess energy supply rose from 12 % to 29 % (Figure 2). Energy deficiency affected 48 % of the PMR fed cows in the fall and only 30 % in the winter.

In the TMR group 44 % in the fall and staggering 50 % in the winter experienced excess energy intakes (Figure 2). The optimum occurred among 33 % in the fall and climbed to 42 % in the winter.

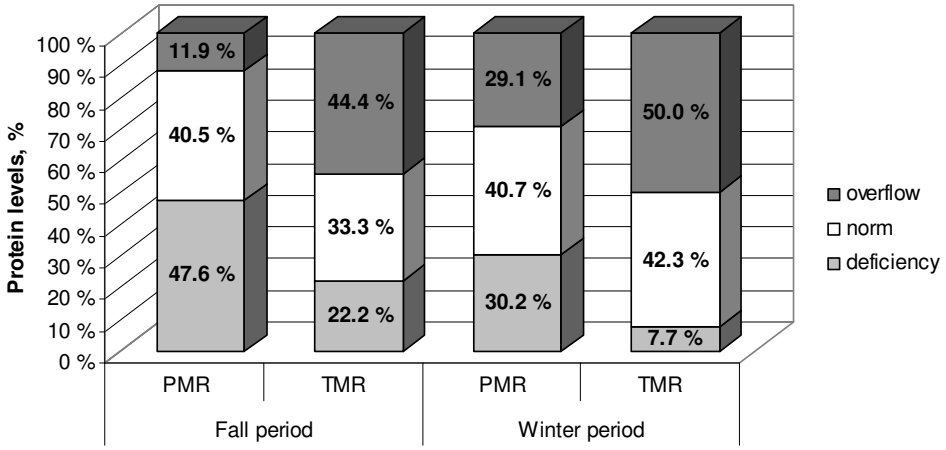

Fig. 2. **Dietary energy supply**

In both study periods the average milk urea content was higher among the PMR than TMR fed cows, but the differences were not statistically significant (Figure 3). Moreover, in both groups the winter milk urea level was higher than the fall level.

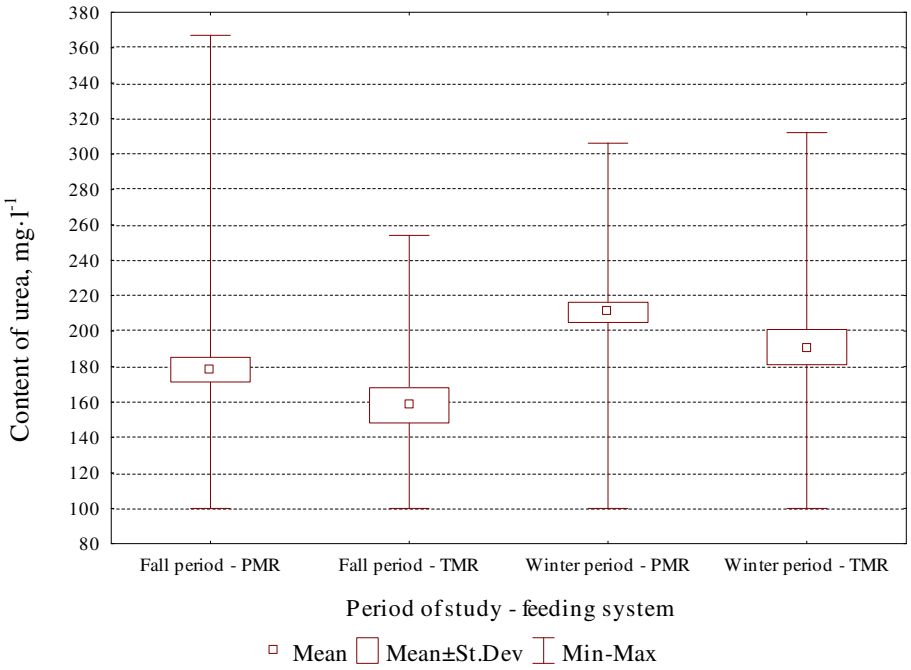

Fig. 3. **Characteristics of milk urea content**

The optimal level of protein supply occurred more often in the PMR fed cows: 61 % and 84 % in the fall and winter as contrasted with 56 % and 77 % in the TMR group.

In the fall, simultaneous optimal supply of both energy and protein occurred among 27 % of the PMR cows and only 15 % of the TMR cows (Figure 5). In the winter the numbers improved slightly for the PMR (30 %) and dramatically for the TMR group (35 %).

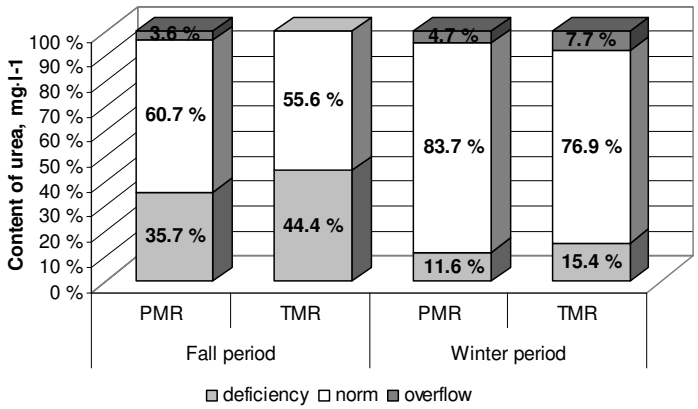

Fig. 4. **Dietary protein supply**

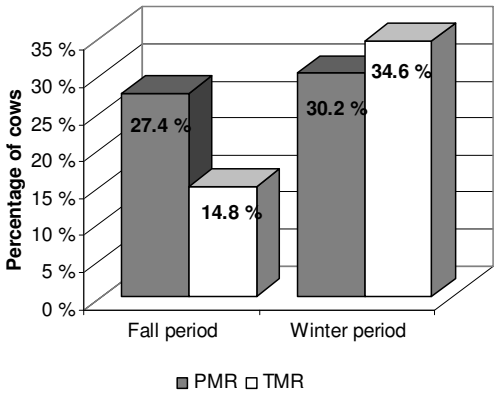

Fig. 5. **Simultaneous optimal supply of both energy and protein**

In [5] and [6] is pointed to the beneficial effect of mixing the forage before feeding on productivity and well-being of cows. At the same time in [7] it is determined that such feeding system improves production profitability. Our own studies suggest that economically rational feeding requires TMR for lower daily yield cows and PMR for higher.

These studies also demonstrated that the percentage of cows fed balanced energy and protein diet was higher in winter than in the fall.

Conclusions

1. The TMR system applied to the whole herd and augmented by nutrition dense concentrates for high-producing cows (PMR) answered the cost-effectiveness concerns of rational feeding.
2. Such diet turned out to be better energy and protein balanced in the winter than in the fall period.

References

1. Brade E., Brade W. Wieviel Korn braucht die Milch? (How much grain needs the milk?). Neue Landwirtschaft, 2008, No. 5, pp. 58-59. (In German).
2. Dohne F., Rerat M. Pansenazidose bei der Milchkuh (Ruminal acidosis in dairy cows). ALP aktuell, 2007, No. 26, pp. 1-4. (In German).
3. Nydegger F., Ammann H., Moriz CH., Rutishauser R. Was bringt das Mischen der Grundration für Milchkühe. In: FAT – Berichte, Tänikon, 2005. 632 p. (In German).
4. Nydegger F., Bolli S. Strukturproblematik bei Mischrationen für Hochleistungsherden. Ergebnisse einer Erhebung auf Milchviehbetrieben. In: ART – Berichte, Tänikon, 2009, No. 719, p. 8. (In German).
5. Engelhard T. Ein Mosaik aus vielen Steinchen (A mosaic of many small stones). Neue Landwirtschaft, 2009, No. 4, pp. 95-98. (In German).
6. Łuczak W., Skurczyńska K., Kuczaj M. Systemy żywienia krów wysokowydajnych łączące pastwisko i TMR (High yielding cows feeding systems combining pasture and TMR). Przegląd Hodowlany, 2009, No. 2, pp. 9-13. (In Polish).
7. Kaźmierczak M., Gaworski M., Kupczyk A. Efekty doskonalenia systemu żywienia bydła mlecznego z wykorzystaniem wozu paszowego. Proceedings of the XIV International Scientific conference "Problemy intensywnej produkcji zwierzęcej z uwzględnieniem ochrony środowiska i standardów UE", IBMER, Warszawa, 2008, pp. 176-180. (In Polish).