Evaluation of feed conversion efficiency for different dairy cows breeds

D. Ruska, D. Jonkus, L. Cielava

Latvia University of Agriculture, Faculty of Agriculture,
Institute of Animal Sciences,
Liela Street 2, LV-3001, Jelgava, Latvia
E-mail: diana.ruska@llu.lv

Introduction

The volatility of the world dairy market and climate change are encouraging farmers to seek the most efficient use of available resources to reduce the environmental impact of their production process and thus reduce production costs. Therefore, it is important to evaluate the composition of the feed ration and to monitor its use. Increasing the conversion efficiency of cattle feed is that less nutrients are excreted in the manure, so feed conversion efficiency affects both economic and environmental efficiency. For an accurate assessment of feed conversion efficiency, is recommended to use Energy Corrected Milk (ECM) to calculate productivity, which will allow comparisons to be made between cows, groups, or farms with different technologies and breeds. One of the recommended calculations of feed conversion efficiency is the ratio of ECM to dry matter intake, depending on lactation and day of lactation (Hutjens, 2005). According to the US National Science Council (NRC), farmers exceed on average 6.6% nitrogen in their diet, resulting in 16% increase nitrogen content in their urine and 2.7% increase nitrogen in their manure (Jonker et al., 2002). One of the factors that stay influence on feed conversion efficiency coefficient is cow genotype. The objective of this study was to evaluate difference of feed conversion efficience between Latvian Brown (LB) and Holstein Black and White (HM) dairy cows breeds.

Materials and methods

The study was conducted from begin of May till the end of July 2019 at the research and study farm of the Latvia University of Life sciences and Technologies. Dairy cows were completed in three groups within Latvian Brown (n=9) and Holsten Black and white (n=15) breeds in each group were presented. Cows were in early lactation phase from 10 to 30 lactation day, with second and third lactation. The cows were housed in a 3x3 Latin square design experiment, three diets over three periods each lasting 21 days. There were analysed data from first phase of experiment lactation phase from 10 to 40 day.

The cows fed *ad libitum* with in farm used prepared total mixed rations (TMR) with crude protein content in diet A, B, C groups 18.0%; 17.5%; 17.0% accordingly.

Every day for each cows were recorded: refused feed and water intake. TMR samples (n=24 samples) for testing are taken from the feed table every second or third and were analysed in accredited laboratory of LLU for dry matter (%), fat (%), protein (%), fibre content (%) etc..

Milk yield (kg) recording and sampling were separate for each milking (n=63). Milk composition was analysed in accredited laboratory content of fat (%), crude protein (%), urea (mg dL^{-1}). Total faecal amount after 21 days were collected over 72 hours from each cow separately (n=24). Faecal sample composition were analysed in accredited laboratory of LLU for dry matter (%), nitrogen (N, %) content.

With an aim to compare and evaluate study results between groups and estimate feed conversion efficiency, milk yield and content were transformed in ECM (ICAR, 2017) by following formula:

$$ECM = (fat\ yield, kg \times 38.3 + protein\ yeild, kg \times 24.2 + milk\ yield, kg \times 0.7832)/3.14 \quad (1)$$

Statistical processing of the data was carried out with *MS for SPSS* (SPSS Inc. Chicago, Illinois, USA) and *MS Office* programme *Excel*.

Results and discussion

The results of the study show significant differences in productivity, feed utilization and faecal output in all study groups between breeds. Average milk productivity traits per cow in the control day in study are present in the Table 1. The milk yield on the control day differs significantly between breeds in all study groups but does not differ between groups within the breed.

Table 1. Average cow milk productivity traits by breed in experiment first phase

Traits	Study groups					
	A		B		C	
	Breeds					
	LB (n=6)	HM (n=15)	LB (n=6)	HM (n=15)	LB(n=6)	HM (n=15)
Milk yield, kg	28.9±2.52^{a}	47.5±1.92^{b}	28.2±2.73^{a}	46.8±1.94^{b}	26.1±2.27^{a}	47.8±2.74^{b}
Fat content, %	4.00±0.015^{a}	3.14±0.181^{b}	3.94±0.104^{a}	3.18±0.338^{b}	4.14±0.149^{a}	2.49±0.309^{b}
Crude protein content, %	3.50±0.162^{a}	2.91±0.086^{b}	3.28±0.95^{a}	2.64±0.287^{b}	3.18±0.080^{a}	1.85±0.304^{b}
Urea content, mg dL^{-1}	28.3±3.55^{a}	26.3±1.14^{a}	28.7±2.04^{a}	21.5±3.14^{a}	28.6±3.42^{a}	22.9±4.88^{a}
ECM, kg	29.1±2.54^{a}	40.6±1.81^{b}	27.6±2.47^{a}	39.3±2.81^{b}	26.2±2.62^{a}	33.2±2.98^{b}

$^{a;b}$ – productivity indicators with unequal letter differed significantly among the breeds in separate group ($p<0.05$)

The milk yield, fat and crude protein content of milk differed significantly between breeds, but there was not significant difference between the groups within one breed. Other scientists have also conducted studies to compare the milk composition of Red and White and black cows. It was found that Estonian red cow's milk has been found to have a higher content of crude protein than Estonian Holstein cows (Joudu et al., 2008).

The mean urea content in milk during the study was within optimal limits for all breeds, 21.5 mg dL^{-1} to 28.7 mg dL^{-1}. In Europe, the optimal urea content in milk is considered to be 15 mg dL^{-1} to 30 mg dL^{-1} (Bijgaart, 2003). The milk urea contents are not significantly different between breeds and groups. Average feed and water intake differs significantly between breeds in all study groups, but not between groups. Found out differences between breeds in feed intake and milk productivity consequence related to faecal output (Fig. 1).

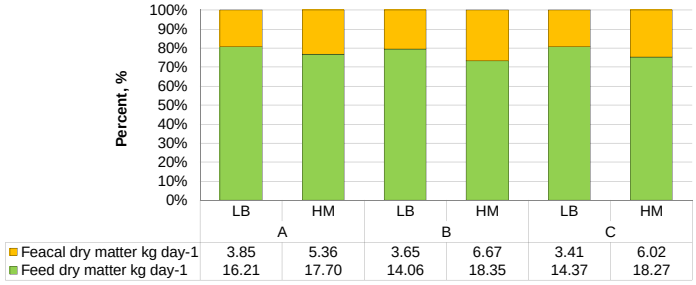

Figure 1. Feed dry matter intake and feacal output by dairy cows breeds in study groups.

To evaluate the conversion efficiency of the feed during the study, we used the ECM and the feed dry matter content and calculated the coefficient for breeds and on average in the study group (Fig.2).

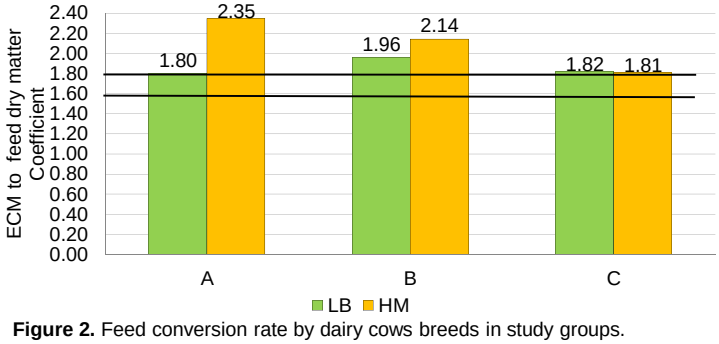

Figure 2. Feed conversion rate by dairy cows breeds in study groups.

The average coefficients for LB breed cows were similar in all groups and did not differ significantly between groups and breeds. The average coefficients of groups A and B for HM breed cows were above the recommended level, and the coefficient of group C was within the recommended range corresponding to level 1.6-1.8 of second lactation, the initial lactation phase (Hutjens, 2005; Arndt et al., 2015). In the study feed conversion efficiency for group C cows for both breeds was most effective.

Conclusions

Milk productivity traits and feed intake were different between LB and HM dairy cows. Milk yield, crude protein content, feed and water intake and faecal amount significantly differ between cows breeds. The conversion efficiency of the feed during the study was optimal for LB breeds cows in all study groups. For HM breeds cows this rate was optimal in C group, in A and B group coefficient was higher than recommended value.

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