REPEATABILITY OF MILK PRODUCTIVITY TRAITS

Liga Paura, Daina Kairisha, Daina Jonkus
Latvia University of Agriculture, Department of Animal Science, Liela Street 2, Jelgava, Latvia, lilz@cs.llu.lv

Abstract. The milk content of 77 cows was tested for milk yield, fat, protein, lactose content and somatic cell count (SCC) every day during one month from 12 July until 11 August, 2001. The final data included 2203 test day samples.

Repeatability of milk yield, protein and somatic cell count was high ranging: from 0.71 to 084; repeatability for fat and lactose was moderate (0.49, 0.30, respectively). Moderate phenotypic correlation existed between the protein and fat contents. Negative phenotypic correlation was found between milk yield and fat content, between milk yield and protein content and between lactose content and somatic cell count.

Keywords: dairy cows, milk productivity traits.

PIENO PRODUKTYVUMO POŽYMIŲ PASIKARTOJIMAS

Santrauka. 77 karvių pieno sudėtis buvo tiriama pagal išmilžį, riebalų, baltymų, laktozės kiekį bei somatinių ląstelių skaičių. Tyrimai buvo atliekami kasdien visą mėnesį ir apėmė laikotarpį nuo 2001 metų liepos 12d. iki rugpjūčio 11d. Sumoje buvo atlikti 2203 tyrimai. Išmilžio, baltymų kiekio bei somatinių ląstelių skaičiaus pasikartojimas svyravo nuo 0.71 iki 0.84. Riebalų ir laktozės kiekis buvo vidutiniškai 0.49 ir 0.30 atitinkamai. Vidutinė fenotipinė koreliacija buvo tarp baltymų ir riebalų kiekio. Neigiama fenotipinė koreliacija buvo aptikta tarp išmilžio ir riebalų kiekio, išmilžio ir baltymų kiekio bei laktozės ir somatinių ląstelių skaičiaus.

Raktažodžiai: Melžiamos karvės, pieno produktyvumo požymiai.

Introduction. In compliance with EU requirements, inspectors of milk recording have started to work and they are also responsible for the control functions. There actual question is: can the quantity and content of milk be changed during the days? So far there have been no investigations on milk content day-to-day changes in Latvia.

As monitoring data shows, cow milk productivity indicators can be subordinated to large changes during the lactation period.

Making investigations of Black-White cows in Germany (Huth, 1995) it is stated that the milk content in the first 14 days of lactation is changing: fats from 6.78 to 4.34%, protein from 6.43 to 3.25% and lactose from 3.47 to 4.98%. Investigations in Latvia of milk and new milk show that content of fats can be between 4.5 and 4.0%, protein – 14.2 to 3.3% and lactose – 3.0 to 4.8% (Jemeļjanova edition, 2001).

Material and methodology. Investigation was made in LLU MPS "Vecauce" Latvian brown cows herd during the period of 12 July until 11 August in 2001. There were 77 cows of the first and later lactation. We calculated the quantity of milk yield, and we also made milk samples that were sent to Kurzeme MAS milk laboratory everyday. Laboratory analysed 2203 milk samples and fixed fat, protein, lactose content with *Milko-Scan 133 B* and the number of somatic cells with *Bentley- Somacount 300*.

Our aim was to fix the content of milk and its amplitude of changes every day during investigation and which of environmental factors were affected the changes of milk content.

Henderson's mixed linear model was applied to study the problem of influence of environmental factors (Table 1) on milk productivity traits.

Results. Milk yield, fat, protein and lactose content of sample group of cows are calculated using day-to-day received milk content traits (Fig.1).

$$y_{ijklmno} = \mu + \alpha_i + AT_j + H_k + L_l + LP_m + GF_n + C_o + e_{ijklmno}$$

$y_{ijklmno}$ – investigated item; μ - general mean;
a_i – cows effect (random);
AT_j - Air temperature C^0 (fixed);
H_k - Humidity% (fixed); L_l - Lactation (fixed);
LP_m - Lactation phase (fixed);
GF_n - Grassland * Fodder (fixed);
C_o - concentrate (fixed), $e_{ijklmno}$ - residual.

Table 1. **Division of included factors in the model**

Factor	Gradation classes
Air temperature C^0	Under 20 C^0; 21 C^0-24 C^0; above 24 C^0
Humidity %	Under 80%; 81%-89%; above 90%
Lactation	1st lactation; 2nd lactation; 3rd and older lactation
Lactation phase	Up to 100 days; 100 – 200 days; 200 and more days
Grassland	Used 1 day; used repeatedly
Fodder	late vegetation granulated green crop; mixed corn granulated lucerne aftergrass; granulated culm grass; hay
Concentrate	Oat + barley; barley + oat

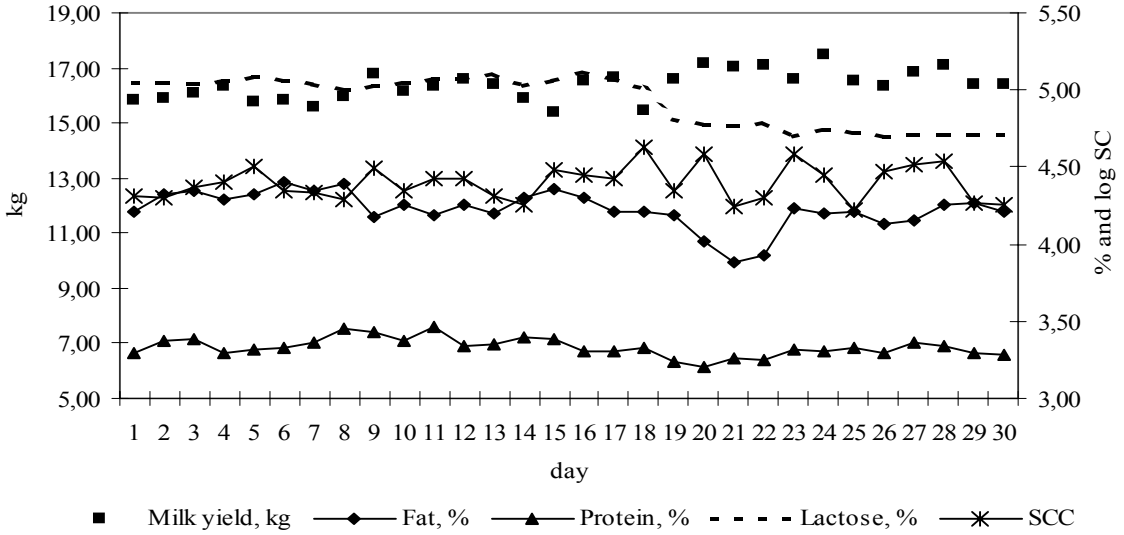

Fig.1. **Changes of milk content during investigation**

The average yield was between 15.9 kg on the 18th day and 17.6 kg on the 24th day during the investigation of sample group cows. The difference was 1.6 kg (9.1% from maximal yield). Milk with the highest fat content was obtained on the 6th day of investigation, and it was 4.40% but the minimal fat content was found on the 22nd day – 3.90%, the difference - 0,5%. There were minimal oscillations of proteins - between 3.46% on the 11th day and 3.20% on the 20th day. Differences of lactose content were a bit smaller than those of fat content during the investigation. It was 5.12% on the 16th day and 4.70% on the 23rd day.

Obtained results show that milk yield and protein are the most stable indicators of milk in sample groups cows, but fat and lactose are less stable. We associate the mentioned changes to the nutriment of green grass that is full of proteins, but it depends on vegetation phase - the level of wood-fibre is changeful.

Results show that lactation of cows in sample group and lactation phase substantially influence milk productivity traits (Table 2). Different grasses influence considerably milk yields, fats, proteins and lactose content. Concentrates influence fat, protein and lactose content in milk.

To estimate the repeatability of milk productivity traits, the correlation between two measures of current and previous days was calculated.

The correlation coefficient value between the current and previous days is starting from 0.31 to 0.92 (Fig. 2).

Table 2. **Analysis of factor influences on milk productivity traits**

Factors	*p-value*				
	Milk yield, kg	Fat content, %	Protein content, %	Lactose content, %	SCC_log
Air temperature C^0	0.38	0.22	0.56	< 0.01	0.81
Dampness %	0.27	0.78	0.03	< 0.01	0.49
Lactation	< 0.01	< 0.01	< 0.01	0.07	< 0.01
Lactation phase	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Grassland* Fodder	0.04	0.02	< 0.01	< 0.01	0.95
Concentrate	0.31	0.01	0.01	< 0.01	0.95

p–value > 0.1 factor is not significant; *p-value* < 0.1 factor is significant
SCC_log = log2 (SCC/100 000) + 3 (DA at al., 1992)

There are higher correlation coefficients for milk yield (0.75 to 0.92) than for protein content (0.52 to 0.90) and somatic cells count (0.60 to 0.85). Lower repeatability is determined for fat and lactose content, where the minimal correlation coefficients are 0.31 and 0.32, respectively.

Analysing repeatability of investigated items in the sample group, we found out it to be from 0.30 to 0.84 (Table 3). Larger repeatability is obtained in such items as milk yield, protein content and of somatic cells count that is 0.84, 0.71 and 0.75 (Table 3). Lower repeatability coefficients were for fat and lactose content.

Repeatability of productivity traits was found higher in second lactation phase than in the first lactation phase excluding trait lactose content. Repeatability of productivity traits was found higher in the second lactation phase.

Together with the evaluations of repeatability coefficients we also obtained phenotypic correlations of

traits.

Average negative correlations (Table 4) were found among milk yield, fat and protein content as well as among somatic cells count, but average positive correlation is calculated among fat and protein content, in accordance with published data in literature (Gagini at al., 1998).

Correlation coefficients among other traits were low.

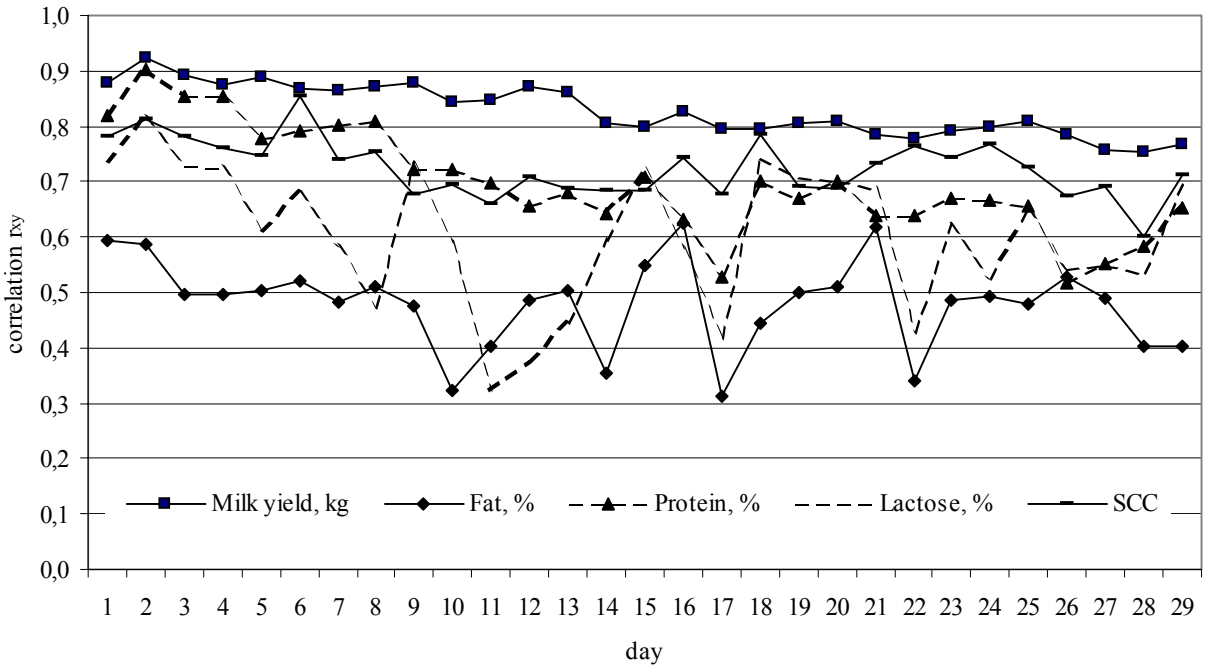

Fig. 2. **Correlation of milk productivity traits between the current and previous measurement days**

Table 3. **Values of repeatability (w^2) and variances (S^2_a; S^2) of milk productivity traits**

Traits	S^2_a	S^2_e	w^2
Milk yield, kg	12.707	2.378	0.84
Fat content, %	0.158	0.165	0.49
Protein content, %	0.067	0.027	0.71
Lactose content, %	0.017	0.039	0.30
SCC_log	2.254	0.757	0.75

Table 4. **Phenotypic correlation between milk productivity traits (n=2203)**

Traits	Fat content, %	Protein content, %	Lactose content, %	SCC_log
Milk yield, kg	-0.373**	-0.476**	0.124**	-0.116**
Fat content, %	1	0.434**	-0.116**	0.064**
Protein content, %		1	-0.256**	0.275**
Lactose content, %			1	-0.398**
SCC_log				1

** $p< 0.01$ (H_0:$\rho=0$ H_1: $\rho>0$)

SCC_log = log2 (SCC/100 000) + 3 (DA at al., 1992)

Conclusion

1. Obtained results in factor influence analysis show that yield, fat, protein and lactose content as well as SCC of the investigated sample group are influenced by lactation phase.
2. Lactation influences all the mentioned milk productivity indicators, except lactose.
3. Feed of different fodder has essential influence on all the investigated milk productivity indicators except SCC.
4. Concentrate changes have large influence on fat, protein and lactose content in milk.
5. There is a close interrelation between the current and previous days: yield (0.75 to 0.92), protein content (0.52 to 0.90) and SCC (0.60 to 0.85). Calculated milk productivity repeatability coefficients confirmed the mentioned results.

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