

The Effect of Lactation Persistence on the Milk Energetic Value

M. Gutić, M. Petrović

Faculty of Agronomy, Čačak, Yugoslavia

Abstract: The effect of lactation persistence on the milk energetic value was studied on 36 cows. The cows produced 4373 l of milk on the average. Milk samples were taken from the start to the end of lactation period every 15 days. During the experiment, 707 samples were collected and tested. The processing of statistical data made it possible to obtain the average milk energetic value of 292,8 joules, followed by standard deviation of 19,31, variation coefficient of 6,59% and variation range from 269,95 to 327,83 joules. Characteristically, the milk energetic value was steadily increasing during the lactation, with its peaks recorded at the end of this period, which suggests a highly positive effect of the lactation on the milk energetic value.

Key words: milk energetic value, milk ingredients, lactation

Introduction

Milk represents the most complex product in the diet of young mammals. In addition to meat, it is the most significant foodstuff in the diet of man of all ages.

The cow's milk-producing ability over the lactation is presented by a dynamic curvature with two phases. The first one took less time, showing rising trend immediately after calving, whereas the second one took more time, showing that cow's milk-producing ability steadily declined towards lactation completion.

Either normal or rising or declining trends on cow's milk-producing ability of differing intensity, can be exposed to a negative or a positive impact of

external factors. Since the cows were kept under appropriate milk-producing conditions, lactation curvature seemed normal. Normal course of lactation enabled us to objectively study milk energetic value during all lactation stages.

Of all scientists studying milk content, particularly chemical one, very few have dealt with milk energetic value so far.

Therefore, the research goal was to thoroughly examine milk energetic value on several samples over the course of lactation.

Materials and method

The experiment was conducted on private holdings in Jagodina. Thirty-six cows were chosen and milk samples taken from each cow every 15 days from the beginning to the end of lactation.

The chemical composition of milk was examined, and its energetic value computed on the basis of energetic values of proteins, lactose and fats, complying with factors of cow's milk proposed by Southgate and Barret (1966) and expressed in KJ (kilo-joules) by Civitas and Kallay in 1980.

During the experiment, 707 milk samples were taken, and obtained results statistically processed in two stages. First, the analysis of variance was made. The mean value of milk energetic value was as separately as entirely calculated for each 15-day period of lactation, i.e. ($\bar{X}$), followed by deviation from the mean value (S_x), standard deviation (S), variation coefficient (CV), variations (min.-max.). In addition, the absolute, cumulative, relative and relative-cumulative frequency of milk energetic value, were also calculated.

Second, the results of milk ingredients were processed in the laboratory, followed by percentage range of milk fats, proteins and lactose, on the basis of which milk energetic value was calculated. The trend of regression line for simple and square regression, was also determined. Standard error of regression and coefficient of correlation and determination were calculated for both regression lines. Further data processing included computation of inter-correlations of the milk and its energetic value, using multiple correlation.

Regression line for a straight line regression was determined, using the following equation:

$$Y_j = by_1 + a$$

where Y_j stands for independent variable, lactation days designated by $y_1 = 1, 2, 3, 4, \dots, 20$, i.e. the days of milk sampling at each 15 days during the experiment.

Dependent variable (energetic value of milk) is marked in the following way:

$$Y_j = Y_1$$

Regression line for parabolic regression was calculated by means of the following equation:

$$Y_j = a \pm by_1 \pm Cy_1^2$$

Marking of symbols was equal to that used in the rectilinear regression. The correlation coefficients for both lines were calculated, using equations.

Results and discussion

Analysing milk production during the lactation, it was found that milk production of all cows averaged 4373 l, followed by daily production averaging 14,33 l, and the average standard production on the first controls.

Tab.1. Production trend of milk energetic value per control periods

Lactation days	daily milk quantity	energetic value of milk
15	21.44	273.52
30	22.89	272.53
45	23.20	269.95
60	22.22	271.38
75	21.36	273.90
90	18.58	278.75
105	17.28	280.86
120	15.08	282.07
135	13.67	284.20
150	12.36	283.99
165	11.78	291.44
180	10.19	293.74
195	9.14	293.45
210	9.14	298.93
225	8.44	301.71
240	8.36	310.31
255	7.36	315.53
270	6.00	325.14
285	5.28	326.94
300	4.95	327.83

Amounting to 21,44 l. The highest daily milk production of 23,20 l was achieved by experimental cows on the 45th day of lactation, i.e. in the third sampling.

Energetic value of milk amounted to $291,81 \pm 4,32$ joules, followed by standard deviation 19,31, variation coefficient 6,59% and variation, ranging from 269,95 to 327,83 joules.

A high standard deviation of the milk energetic value during lactation was expected, since it was computed from milk ingredients.

Tab.2. Variation of the basic milk ingredients and its energetic value during the lactation

Ingredients	$X \pm S_{\text{ex}}$	S	CV	variations	
				min	max
Fats (%)	3.91±0.09	0.410	10.48	3.51	4.55
Lactose(%)	4.63±0.005	0.207	4.484	4.54	4.66
Proteins(%)	3.56±0.072	0.321	9.017	3.22	4.24
Ener.value(J)	292.81±4.32	19.31	6.59	269.95	327.8

The frequency of milk energetic value was ranged in 15 limiting classes from 250 to 434 joules, which is tabulary and graphically presented.

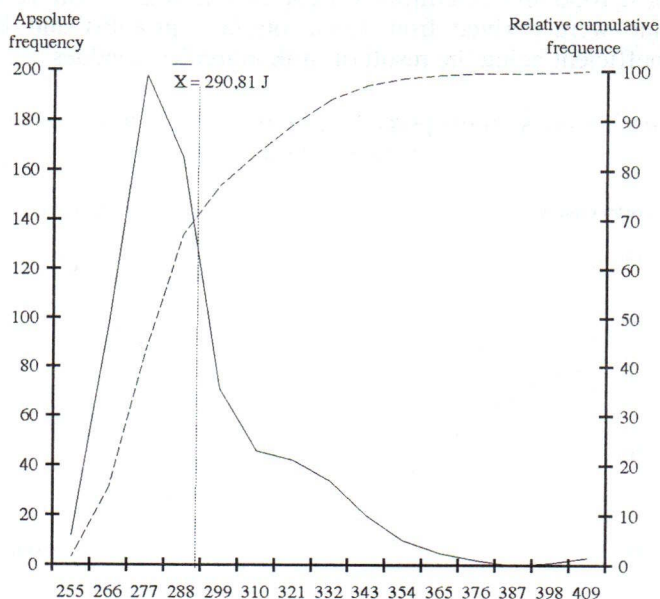
Tab.3. The Frequency the Milk Energetic Value

Limiting classes energetic value(J)	The mean value of the class	The frequency of the milk			
		absolute	cumulative	relative%	relat. cumul%
250-260	255	12	12	1.698	1.698
261-271	266	98	110	13.860	15.558
272-282	277	198	308	28.006	43.564
283-293	288	165	473	23.338	66.902
294-304	299	71	544	10.042	76.944
305-315	310	46	590	6.507	83.451
316-326	321	42	632	5.941	89.392
327-337	332	34	666	4.810	94.202
338-348	343	20	686	2.828	97.030
349-359	354	10	696	1.415	98.445
360-370	365	5	701	0.708	99.153
371-381	376	2	703	0.280	99.433
382-392	387	-	703	-	99.433
393-403	398	1	704	0.142	99.575
404-414	409	3	707	0.425	100.00

In all limiting classes, the milk energetic value ranged from 253,6 to 423,6 joules. Variation range was 170 joules or 16% compared with the lowest value.

The greatest number of samples (198 or 28,00%) had energetic value from 272-282 joules. Below and above the limiting class were concentrated classes with a high number of samples, with 81,7% accounting for the values from 261 to 315 joules. The samples were more scattered to the end of the limiting classes whose values were reported after the lactation had been completed.

Fig.1. The Absolute and Relative Cumulative Frequency of the Milk Energetic Value



Tab.4. Correlation coefficients of the milk chemical composition, its energetic value and lactation

	Linear ($Y_j=a+by_1$)			Square ($Y_j=a+by_1+cy_1^2$)		
	Simple correlat coefficient	Standard error of regression	Determinat. coefficient (%)	Simple correlat coefficient	Standard error of regression	Determinat. coefficient (%)
Milk ingredients versus lactation days $Y_j Y_1$						
Energetic values ($Y_j Y_1$)	0.9625	0.0111	92.6	0.9926	2.1606	98.5

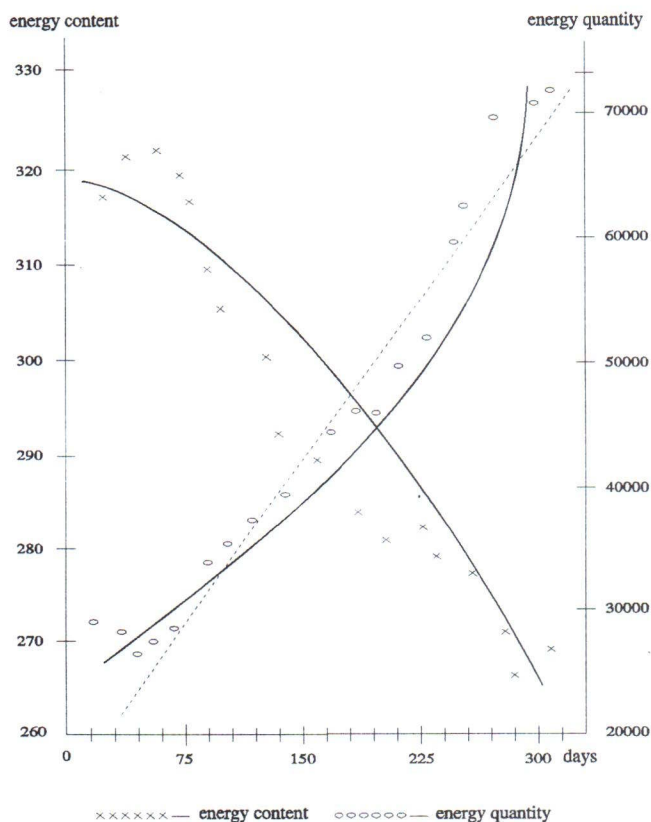
Tab.5. Regression lines equations on the milk macro-ingredients and its energetic value in the function of lactation

Elements	Regression coefficients		
Straight line $Y = a \pm by_1$			
Parabola $Y = a \pm by_1 \pm cy_1^2$	a	b	c
Energetic value			
Straight line	$Y_1=259.7674$	+	$0.2097y_1$
Parabola	$Y_1=271.6403$	-	$0.0060y_1 + 0.00068y_1^2$

Changes in milk energetic value in lactation, were established for the regression line equation by means of coefficient 0,9625, with standard error of

regression 0,0111 and determination coefficient 92,6%. As for parabola, its correlation coefficient approximated ideal value, amounting to 0,9926, with standard error 0,1606 and determination coefficient 98,5%. The results on milk energetic value were derived from those on fats, proteins and lactose, with correlation coefficient being the result of milk ingredients values.

Fig.2. Regression lines on the percentage and quantity of milk energetic value during lactation



Conclusion

Lactation period, which had a marked impact on milk energetic value, was studied on 36 cows owned by private holdings in Jagodina. Milk production averaged 4.373 l. Milk samples were taken every 15 days from the start of lactation to its end. During the trial, 707 samples were taken and tested. Based on the statistical data processing, we concluded that the average milk energetic value during the lactation amounted to 292,81 joules, followed by standard

deviation 19,31, variation coefficient 6,59% and standard variations from 269,95 to 327,83 joules.

Analysing the frequency of milk energetic value, we obtained the values ranging from 253,6 to 423,6 joules, with variation range 170 or 16% compared to the lowest value.

The greatest number of samples 198 or 28% had the energetic value from 272 to 282 joules (the average being 277). Below and above the limiting value were concentrated the classes with a large number of samples, i.e. 81,7% accounting for the values in the range from 261 to 315 joules. Scattering of the samples appeared to be more expressed towards the end of limiting classes.

The changes in the milk energetic value during lactation, were determined in order to obtain straight equation of regression line by means of the coefficient 0,9625, standard error 0,0111 and determination coefficient 92,6%.

As for parabola, its correlation coefficient was found to approximate the ideal value of milk in the course of lactation, amounting to 0,9926. The determination coefficient of the parabola amounted to 98,5%.

As can be seen from the tables and graphs, the results on the milk energetic value and its basic ingredients significantly varied during the lactation, with an increasing trend noticed from the beginning of lactation till its completion when the peaks occurred.

References

- Dozet Natalija, Stanišić, M., Bijeljac, S. (1979): Izučavanje fizičko - hemijskog svojstva i kvaliteta mlijeka. *Mljekarstvo* broj 7, Zagreb.
- Dozet Natalija, Stanišić, M., Sumanić, S. (1975): Izučavanje sezonskih promjena fizičkih konstanti mlijeka. IV Jugoslovenski kongres o ishrani. Zbornik radova, Ohrid.
- Đorđević, J., Zeremski, D., Stefanović, R., Mišić, D., Petrović, D. (1971): Uticaj energetske vrednosti obroka na sastav kravljeg mleka. Jugoslovenski simpozijum iz stočarstva. Zbornik radova. Beograd.
- Miletić, S., Skelin, J. (1976): Varijacije kvaliteta sirovog i pasterizovanog mlijeka. *Mljekarstvo* broj 5. Zagreb.
- Miletić, S. (1977): Varijacije energetske vrijednosti pasterizovanog mlijeka. *Mljekarstvo* broj 8. Zagreb.
- Gutić, M. (1987): Prilog poznavanju stepena iskorišćenosti genetskog potencijala muznih krava kroz laktaciju. Zbornik radova APRO IRI- Mostar, str. 159-175.
- Vasić, J. (1973/74): Promene nekih fizičkih i hemijskih osobina mleka u toku laktacionog perioda. Zbornik radova Poljoprivrednog fakulteta u Sarajevu, broj 24-25. Sarajevo.

ISPITIVANJE UTICAJA PERZISTENCIJE LAKTACIJE NA ENERGETSKU VREDNOST MLEKA

-originalni naučni rad-

M. Gutić, M. Petrović

Faculty of Agronomy, Čačak

Rezime

Ispitivanje uticaja perioda laktacije na energetske vrednosti mleka krava obavljeno je na 36 krava kod individualnih proizvođača. Krave su ostvarile prosečnu proizvodnju mleka od 4373 litara. Uzorci mleka uzimani su od početka do kraja laktacije svakih 15 dana. U toku oglada uzeto je i ispitivano 707 uzoraka. Statističkom obradom podataka došli smo do zaključka da je prosečna energetska vrednost mleka u laktaciji iznosila 298.81 džula, standardna devijacija 19.31, varijacioni koeficijent 6.59% i varijacije su bile od 269.95 do 327.83 džula.

U obradi i učestalosti pojavljivanja energetske vrednosti mleka karakteristično je da se vrednosti kreću od 253.6 do 423.6 džula. Raspon variranja iznosi 170 ili 16% u odnosu na najmanju vrednost.

Najveći broj uzoraka mleka 198 ili 28% imao je energetske vrednosti od 272 do 282 džula (prosek 277). Ispred i iza ove granične vrednosti koncentrisane su klase sa visokim brojem uzoraka, tako da vrednost od 261 do 315 džula ima 81.7% uzoraka. Rasutost uzoraka je veća u krajnjim graničnim klasama.

Promena energetske vrednosti mleka u toku laktacije utvrđena je za pravu jednačinu regresione linije koeficijentom 0.9625 sa standardnom greškom regresije od 0.0111 i koeficijentom determinacije 92.6 %.

Za parabolu koeficijent korelacije se približava idealnoj vrednosti i iznosi 0.9826. Koeficijent determinacije za parabolu iznosi 98.5%.

Rezultati energetske vrednosti mleka u toku laktacije, kao i osnovne komponente iz kojih je izračunata značajno su varirale, tako da se vrednost povećavala od početka prema kraju laktacije kada je energetska vrednost imala značajno više vrednosti, a što je prikazano tabelarno, grafički.