

Seasonal Influences on Milk Yield and Composition Dynamics during a Normal Lactation in Dairy Cows. Milk Lactose, Solids Non Fat, Total Dry Matter Percentage

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Abstract

Researches were made on 125 lactations from Romanian Black Spotted cows, aimed at studying the evolution of the interval between calving on milk quantity and quality. Data were recorded and statistically analyzed by means of ANOVA/MANOVA determining the average values and dispersion indices. Based on averages parameters of lactation curves were calculated using the mathematical model proposed by Wood in 1967, called the incomplete gamma function. Lactation curve for lactose percentage was very different among seasons. Significant differences ($p < 0.05$) were observed between summer-winter and spring-autumn, and distinct significant differences ($p < 0.01$) between summer and spring. Flat pattern of the lactation curve for solids non fat percentage had the same shape for all seasons with distinct significant differences ($p < 0.01$) between winter and autumn and very significant differences ($p < 0.001$) between summer and autumn and spring and autumn.

Keywords: calving season; dairy cows; lactose; milk quantity; proteins; Romanian Black Spotted cows; solids non fat; total dry substance.

1. Introduction

One of the causes achieving lower production of milk per lactation in cows that are calving in summer compared to autumn-winter calving, is the high environment temperature, which reduces appetite and thus reduce cow feed consumption during ascending and lactation curve plateau [1]. Also, at cows that are calving in autumn – winter, balanced feeding with conserved forage in early lactation when milk synthesis physiological intensity is high, accompanied by stimulating the secretion of milk by green fodder in the spring (when the lactation curve is in a downward phase)

ensure a consistently high level of secretion and thus a higher milk production throughout lactation [2].

Higher values of total dry milk in cows when calving in autumn and winter, is recorded in temperate climates and are caused by humidity, ambient temperature and other factors, including the type and level of feeding [3].

Velea and co-workers showed that the highest milk yields are obtained in winter calving that are superior to 4-30% to cows that calved in autumn, with 10-26% to those that calved in the spring season and 31-44% to those that calved in summer (based on the lactation reference) [4].

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2. Materials and methods

Researches were made in the Didactical Farm of the Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara, on 125 lactations from Romanian Black Spotted cows. Data were recorded and statistically analyzed by means of ANOVA / MANOVA determining the average values and dispersion indices. Based on averages parameters of lactation curves were calculated using the mathematical model proposed by Wood, called the incomplete gamma function [5].

3. Results and discussion

Table 1 presents the mean and dispersion indices for incomplete gamma function parameters, for the percentage of lactose in a normal lactation per day, depending on the season of calving for cows from Romanian Black Spotted breed.

The percentage of lactose in the first day of control (parameter a) was the lowest in cows that calved in winter, 4.58%, followed by cows that calved in spring, where the amount of lactose percentage was 4.68% and those that calved in autumn with a value of 4.71% lactose percentage. The highest value of the percentage of lactose achieved a cow calved in summer (4.78%).

Daily growth rate of the percentage of milk lactose (parameter b) had the highest value from cows that have calved in spring 0.081%. The lowest value of this parameter is obtained from cows that calved in winter (0.011). The values of the parameter b describing the rate of increase in the percentage of lactose in milk until reaching lactation curve peak.

The daily rate of decline in the lactose percentage from milk (parameter c) was the lowest from cows that have calved in autumn, only 0.00006 %, then increasing the value of 0.00007% in cows that calved in summer and winter. The biggest daily percentage drop rate of lactose was obtained from cows that have calved in spring (0.00008%).

From Figure 1 it is found that cows that calved in winter and spring were selected curve similar in appearance. That is, the initial rate of lactose was low (4.58% and 4.68% winter spring) which then increased sharply in the second control to 4.75% 4.80% winter and spring. The highest percentage of lactose was recorded at 154 days of lactation in winter and 103 days of lactation in spring, because at

the end of normal lactation average percentage of lactose in milk is approximately equal approx. 4.8%. Cows that calved in summer recorded the flatter lactation curve for the percentage of lactose. Thus, the maximum proportion of 4.79% was reached at 19 days after birth, and then gradually decreased at a rate lower to the value of 4.72% at the end of lactation.

It should be noted that none of the seasons, changes in the percentage of lactose in milk has joined the typical curve for this component.

Table 2 shows the mean values and dispersion indices for incomplete gamma function parameters in percentage dry non fat matter on normal lactation day depending on the season of calving cows Romanian Black Spotted studied.

The percentage of dry non fat matter from milk on control day (parameter a) was the lowest in cows that calved in winter 8.32%, followed by those that calved in spring 8.48% increase in cows calved in summer (8.68%) reaching maximum value from cows that have calved in autumn (9.33%).

Daily drop rate percentage of dry non fat matter (parameter b) had minimum values at cows that have calved in spring (-0.0070%), value close to that obtained from cows that calved in summer (-0.0085%) and increases in cows that have calved in autumn (-0.0137) and reaches maximum value for cows that calved in winter (-0.0155%).

The daily rate of increase in the percentage of fat-free dry matter (parameter c) was the lowest in cows that calved in winter (-0.00006%) and higher than those that calved in spring (-0.0008%). The highest rate of decline in the percentage of fat solids obtained from cows that have calved in autumn (0.00015%).

Figure 2 shows that the appearance of the lactation curve for percentage of dry non fat matter in all seasons is of nearly linear form, is high on the first day of control, then begins to decrease in the first month of lactation, remains constant in the second month of lactation and by the end of lactation is a slight increase.

Table 7.3 presents the average values and dispersion indices for incomplete gamma function parameters to the percentage of total solids (percent) per day depending on the season normal lactation cows calving in the Romanian Black Spotted studied.

The percentage of total solids in milk on the first day of control (parameter a) was highest from cows that

have calved in autumn (14.22%), followed by cows that calved in summer (13.19%) and minimum the percentage of total solids obtained from cows that calved in winter (12.50%).

Daily rate decrease in the percentage of total solids (parameter b) has the minimum value from cows that have calved in spring (-0.0103%) nearly doubles obtained from cows that calved in winter

(-0.0239%), and reaches maximum at autumn calved cows (0.0027%).

The daily rate of increase in the percentage of total solids (parameter c) was the lowest in cows calved in spring (-0.00012%) and those that calved in winter (-0.00013%). The maximum rate of increase in the percentage of total solids obtained from cows that have calved in autumn (0.00028%).

Table 1. Averages and dispersion indices for the incomplete gamma equation parameters for the daily lactose percent on normal lactation based on calving season of the Romanian Black and White cows

Calving season	n	Normal lactation								
		a			b			c		
		X±S _x	s	cv (%)	X±S _x	s	cv (%)	X±S _x	s	cv (%)
summer	34	4.78170±0.06948	0.40511	8.47	0.01360±0.00022	0.00130	9.55	0.00007±0.000003	0.00002	28.57
winter	19	4.58160±0.06870	0.29946	6.53	0.01139±0.00044	0.00193	16.94	0.00007±0.000002	0.00001	14.28
spring	35	4.68594±0.08340	0.49341	10.52	0.08170±0.00052	0.00275	3.36	0.00008±0.000005	0.00003	37.5
autumn	37	4.71735±0.05570	0.33883	7.18	0.04300±0.00032	0.00199	4.62	0.00006±0.000003	0.00002	33.33

Table 2. Averages and dispersion indices for the incomplete gamma equation parameters for the daily solids non-fat percent on normal lactation based on calving season of the Romanian Black and White cows

Calving season	n	Normal lactation					
		a		b		c	
		X±S _x	s	X±S _x	s	X±S _x	s
summer	34	8.68865±0.13430	0.78309	-0.00859±0.00043	0.00255	-0.00013±0.000004	0.00003
winter	19	8.32523±0.21109	0.92011	-0.01554±0.00078	0.00341	-0.00006±0.000006	0.00003
spring	35	8.48735±0.14947	0.88426	-0.00707±0.00052	0.00311	-0.00008±0.000004	0.00003
autumn	37	9.33824±0.17593	1.07015	-0.01379±0.00046	0.00284	-0.00015±0.000004	0.00002

Table 3. Averages and dispersion indices for the incomplete gamma equation parameters for the total dry matter percent on normal lactation based on calving season of the Romanian Black and White cows

Calving season	n	Normal lactation					
		a		b		c	
		X±S _x	s	X±S _x	s	X±S _x	s
summer	34	13.19479±0.43094	2.51279	-0.01110±0.00918	0.005352	-0.00015±0.000008	0.00005
winter	19	12.50579±0.36640	1.59709	-0.02395±0.00084	0.003692	-0.00013±0.000006	0.00003
spring	35	12.81635±0.63127	3.73463	-0.01030±0.00114	0.004747	-0.00012±0.000009	0.00005
autumn	37	14.22964±0.40198	2.44516	-0.02739±0.00801	0.004873	-0.00028±0.000006	0.00004

In Figure 3, it is observed that the appearance of the lactation curve by calving season is very flat. In all seasons the percentage of total solids is maxim on the first day of lactation and then begins to decline in the first month of lactation and remained constant until the end of lactation.

Table 4 shows the differences and statistical significance for incomplete gamma function parameters to changing chemical components of milk during lactation by cows calving season the Romanian Black Spotted studied. From the table it can be seen that there were significant differences (p < 0.05) for the evolution of the daily quantity of milk, in the daily loss rate (parameter c) and the amount of milk in the season of spring and autumn (0.00160). For the rest of the seasons there were

no significant differences (p>0.05). Daily developments in the percentage of lactose (the parameter a) by calving season recorded significant values (p<0.05) between summer and winter (-1.18941%), spring - autumn (0.03141%), and distinct significantly differences (p<0.01) between summer and spring season (0.09576).

Daily growth rate (parameter b) of the percentage of lactose in milk had significant differences (p < 0.05) between the winter season, the spring (0.07031%), spring and autumn (0.03870%). Significant differences (p<0.01) were obtained between summer and spring seasons (-0.06810%). For decreasing daily rate (parameter c) the percentage of lactose in milk were obtained significant differences (p<0.05) between the spring and autumn season

(0.00002%), and significant differences ($p < 0.01$) between summer and spring season (0.00001%) and winter and spring (0.00001).

Daily developments in the percentage of dry defatted (parameter a) by calving season and recorded values significantly distinct ($p < 0.01$) between winter- autumn season (1.01301%) and highly significant values ($p < 0.001$) between summer and autumn seasons (0.64959%) and spring autumn (0.85089%).

For decreasing daily rate (parameter b) the percentage of non-fat solids of the milk obtained significant differences ($p < 0.05$) between the fall - winter season (0.00847%), and significant differences ($p < 0.001$) were obtained between summer and autumn seasons (-0.00520%), spring-autumn (0.00672%).

Daily growth rate (parameter c) the percentage of non-fat solids of the milk obtained significant differences ($p < 0.05$) between summer and autumn

season (0.00002%). For the other seasons, there were no significant differences ($p > 0.05$).

Daily developments in the percentage of total solids (parameter a) by calving season recorded significant values ($p < 0.05$) between summer and winter season (0.68900%), spring-winter (1.41329) and distinct significantly values ($p < 0.01$) between summer and autumn seasons (0.64959%).

Daily rate of decline (parameter b) the percentage of total solids in milk were obtained significant differences ($p < 0.05$) between summer and winter season (0.01285%), spring - autumn (0.01709%), and significant differences ($p < 0.01$) was obtained between the summer and winter seasons (0.01629%).

Daily growth rate (parameter c) the percentage of total solids in milk yielded significant differences ($p < 0.05$) between summer and winter season (0.00002%), summer-spring (0.00003%) and summer-autumn (0.00013%). For the other seasons, there were no significant differences ($p > 0.05$).

Table 4. Differences and their significance for the incomplete gamma equation parameters for daily evolution of milk quantity and chemical components during lactation based on calving season

Trait	Calving season	Parameter	Calving season		
			autumn	spring	winter
Lactose (%)	summer	a	ns	0.09576**	-1.18941*
		b	ns	-0.06810**	ns
		c	ns	-0.00001**	ns
	winter	a	ns	ns	-
		b	ns	-0.07031*	-
		c	ns	-0.00001**	-
	spring	a	0.03141*	-	-
		b	-0.03870*	-	-
		c	-0.00002*	-	-
Dry matter non fat (%)	summer	a	0.64959***	ns	ns
		b	-0.00520***	ns	ns
		c	-0.00002*	ns	ns
	winter	a	-1.01301**	ns	-
		b	0.00847*	ns	-
		c	ns	ns	-
	spring	a	0.85089***	-	-
		b	0.00672***	-	-
		c	ns	-	-
Dry matter (%)	summer	a	-1.03485**	ns	0.68900*
		b	-0.01629**	ns	0.01285*
		c	-0.00013*	0.00003*	-0.00002*
	winter	a	ns	ns	-
		b	ns	ns	-
		c	ns	ns	-
	spring	a	-1.41329*	-	-
		b	-0.01709*	-	-
		c	ns	-	-

ns – $p > 0.05$; * - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$

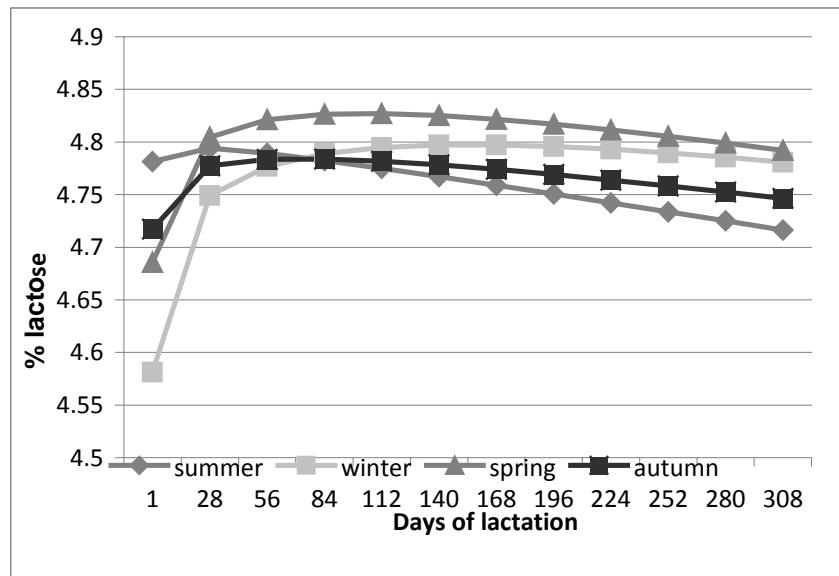


Figure 1. Evolution of the milk lactose percentage during the normal lactation according to the calving season of Romanian Black and White cows

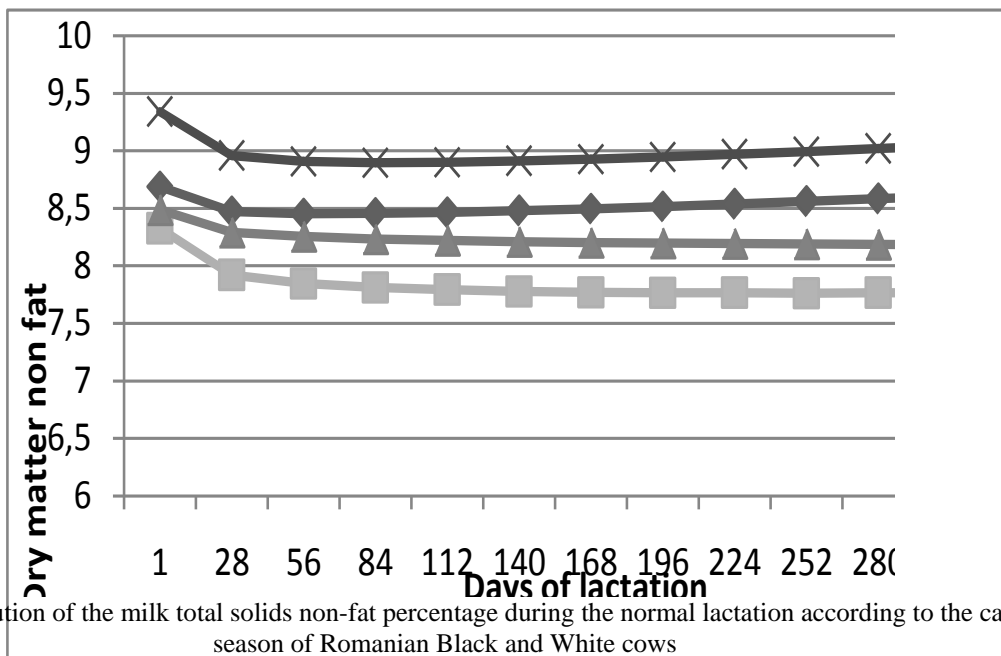


Figure 2. Evolution of the milk total solids non-fat percentage during the normal lactation according to the calving season of Romanian Black and White cows

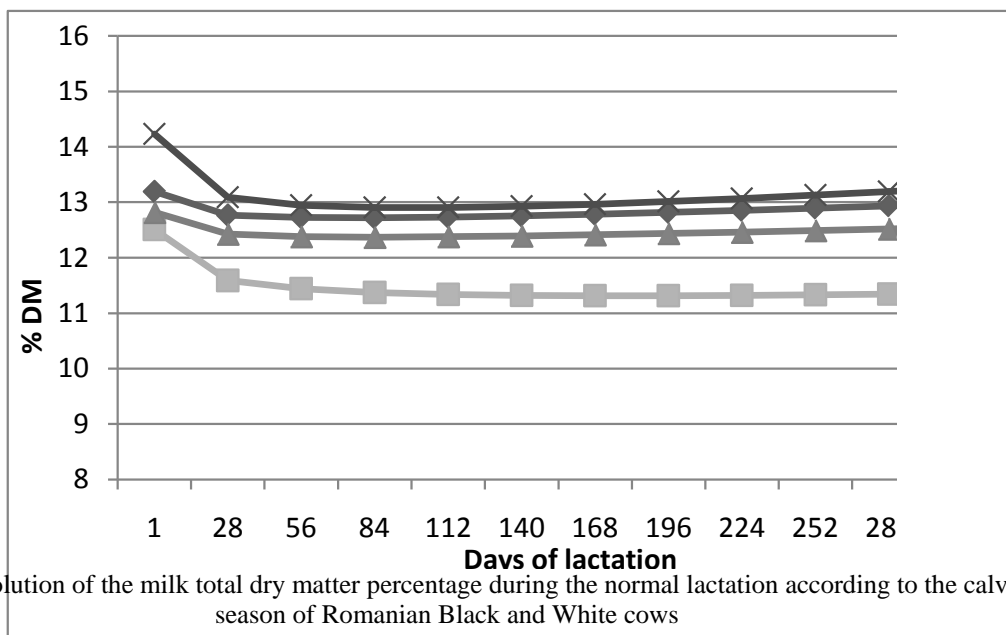


Figure 3. Evolution of the milk total dry matter percentage during the normal lactation according to the calving season of Romanian Black and White cows

4. Conclusions

Lactation curve for milk lactose percentage was very different from one season to another recorded significant differences ($p < 0.05$) between summer and winter season and spring-autumn, significant differences ($p < 0.01$) between summer and spring season. Lactation curve for the percentage of lactose were similar to that of milk, the same sharp shape.

Flattened appearance of the lactation curve for percentage of dry defatted milk was maintained for all seasons, with significant differences ($p < 0.01$) between winter-autumn season, and significant differences ($p < 0.001$) between seasons summer autumn and spring-autumn.

Linear regression of the curve of the lactation for the percentage of the total dry matter of the milk had the same shape for all seasons. Evolution of

the percentage of total solids in winter was significantly ($p < 0.05$) lower throughout lactation to autumn, summer and spring.

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