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EFFECT OF CALVING INTERVAL ON MILK YIELD IN JERSEY COWS UNDER CONDITIONS OF SMALL FAMILY FARMS IN ALBANIA

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Sažetak

Effect of calving interval on 305 day milk yield for first three lactations was studied in order to increase efficiency of selection schemes and to more efficiently manage Jersey cows that have been raised on small scale family farms in Albania. Results obtained by processing data of 1476 cows, managed in 935 small scale family farms, pointed out that current calving interval significantly affects on milk production for first three lactations ($p<0.05$). Preceding calving interval affected 305 day milk yield ($p<0.05$) in second lactation only. Linear regression model accounted for 20-25 % of the total variance of 305 day milk yield. Extension of calving interval over 420, 430, 450 days for first, second and third lactations respectively, did not increase milk production when converted to 305 day lactation. Stochastic relations between calving interval and calving age and month are moderated. Values of Pierson's correlation coefficients ranged 0.38 to 0.69. Adjustment of milk production in order to reduce effect of calving interval on total phenotypic variance of milk yield is valid for first lactation only. Adjustment of 305 day milk yield for second and third lactations in order to reduce effects of factors "calving age and month" brings about, at the same time, elimination of calving interval effect.

Ključne riječi: milk production, small family farm, calving interval

Uvod

Length of calving interval is one of non genetic factors affecting milk yield in cattle. It is known that length of calving interval depends on length of days open, whose variance is conditioned by different environmental factors such as: feeding, production system, AI technician's skills, management skills of farmer etc. To make possible an efficient selection of cows, the literature recommends that along side different adjustments, 305 day milk yield should be adjusted to reduce effect of calving interval on its total variance (Hanset, 1978; Leroy, 1980; Kume, 1989; Jamrozik, 1997; Biçoku, 1995; Nebel, 2001).

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Study of calving interval effect on total variance of current lactation or next one is necessary to decide of how, the adjustment of milk yield to reduce effects of this non genetic factor has to be made. This study is especially necessary to the case of cows' selection, which are managed in small scale family farms (on the average 2-3 heads) under conditions of low input production system. In this case, the variation of milk production from normal physiological course occurs very often. Non typical lactation curves are highly present. As a consequence, effect of calving interval on 305 day milk yield is not similar or comparable to those given in literature. Study and estimation of these effects is necessary in order to identify and analyze causes of calving interval variation and their relations with 305 day milk yield under conditions of small scale family farm characterized by low input production system. In this way, effect of different non genetic factors on these variations can be assessed, making possible the setting up and applying efficient and adequate selection schemes under conditions of small scale family farms.

Material and method

Data for 305-day milk yield of 1476 cows that have been managed on 935 small scale family farms were analyzed. Structure of data regarding the number of lactations and length of calving interval for current and next lactations are given in table 1.

Table 1. – NUMBER OF LACTATIONS ACCORDING TO LENGTH OF CALVING INTERVAL

Length of calving interval	Current calving interval (CCI)			Preceding calving interval (PCI)	
	Lact. I	Lact. II	Lact. III	Lact. II	Lact. III
< 290	21	18	11	18	11
291-310	82	24	18	21	16
311-330	86	32	24	28	24
331-350	110	67	54	67	34
351-370	136	124	92	94	63
371-390	107	131	88	109	76
391-410	112	70	91	65	41
411-430	55	11	6	11	6
431-450	63	33	12	33	12
451-470	54	26	7	26	7
471-490	82	59	19	32	13
> 490	27	12	10	12	10

Data for first complete three lactations previously converted to 305 day milk yields were used to study effect of calving interval on total variance of milk yield for first three lactations. Data of 305 day milk yield for each of lactations were analyzed according to a GLM procedure as follows:

$Yijklm = \mu + ai + bj + hk + Il + eijklm$ (1), where:

Yijklm – 305 day milk yield
μ – means of population
ai – effect of calving age
bj – effect of calving month
hk – effect of herd
Il – effect of length of calving interval
eijklm – ijklmth residual random effect (0, σ2e)

Factor "herd" means the interactions between factors related to production system which is applied in farm, such as: level of inputs, effect of farmer. Annual average milk yield achieved in farm, is used as quantitative indicator to characterize factor "herd". Small scale family farms are grouped into 4 classes according to annual milk yield (table 2).

Table 2. – NUMBER OF FARMS ACCORDING TO LEVEL OF ANNUAL MILK YIELD

< 2300 kg	2301-2600 kg	2601-2900 kg	> 2900 kg
124	378	284	149

To estimate effects of non genetic factors - calving age, calving month, herd and number of lactation on calving interval, following linear model was used:

$Yijklm = \mu + ai + bj + hk + Ll + eijklm$ (2), where:

Yijklm – length of calving interval
μ – mean of population
ai – effect of ith calving age in months (10 classes: < 23, 24-26, 33-35, 36-38, 39-41, 44-46, 47-49, 50-52, 53-55, > 56)
bj – effect of jth calving month (4 classes: January-March, April-June, July-September, October-December)
hk – random effect of kth herd
Ll – effect of lth parity
eijklm – ijklmth residual random effect N (0, σ2e)

Results and discussion

Analyze of variance carried out according to requests of linear regression model (1) gave results shown in table 3 and table 4.

Table 3. – ANALYZE OF VARIANCE OF CALVING INTERVAL (F)

Source of variance	Current calving interval			Preceding calving interval	
	Lact. I	Lact. II	Lact. III	Lact. II	Lact. III
Calving age	2.09*	1.78*	0.72	1.08	0.92
Calving month	3.56**	2.15**	2.01*	2.97*	2.68*
Herd	4.73***	3.04**	2.95**	4.04**	3.15**
Calving interval	2.01*	1.96*	1.76*	1.82*	1.09

* (P<0.05); ** (P<0.01); *** (P<0.001)

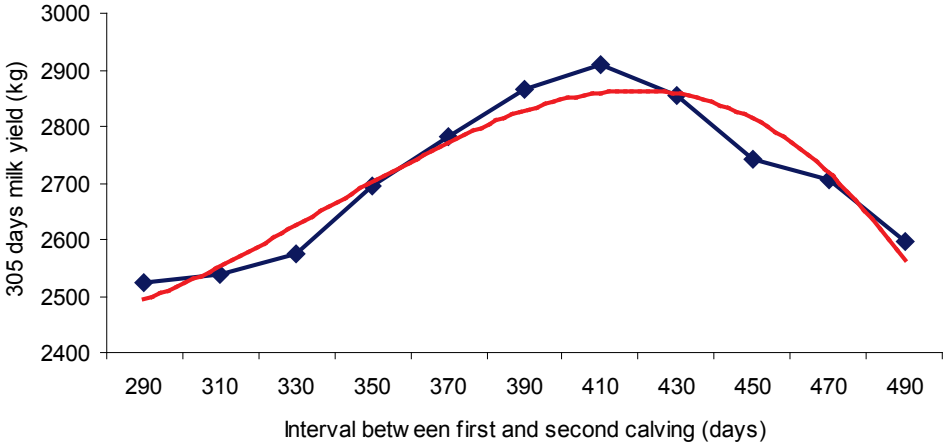
Current calving interval is a factor that shows significant effect ($p<0.05$) on variations of milk yield for first three lactations . Preceding calving interval affects on milk production ($p<0.05$) in second lactation only. Part of total phenotypic variance of milk production explained by linear model is given in table 4. On the average, linear models explain 20 to 25% of total variance. These results are comparable to those given by Kume (1989), Leroy (1980), Biçoku (1995), Arbel et al. (2004).

Table 4. – VALUE OF CORRELATION COEFFICIENT (R2)

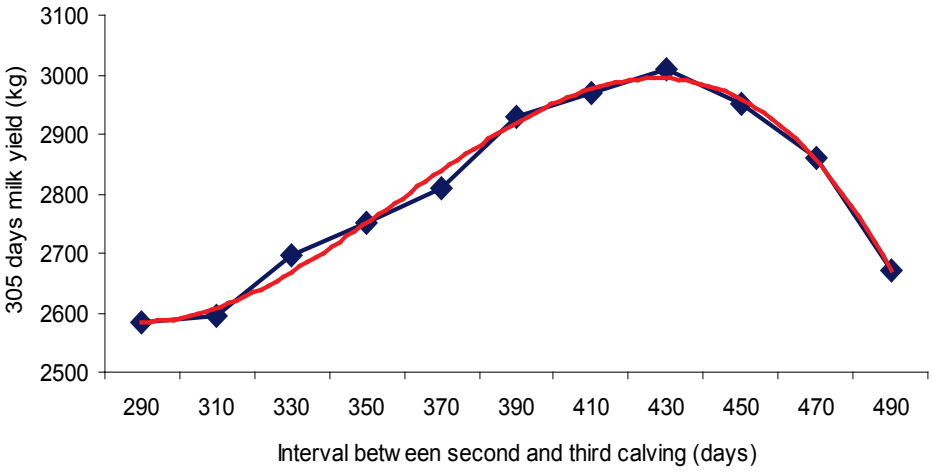
	Current calving interval			Preceding calving Interval	
	Lact. I	Lact. II	Lact. III	Lact. II	Lact. III
R^2	25.3	22.6	19.8	21.7	22.3

Study of relations between milk production and calving interval should be carried out by quantitative modeling of these relations. Least square means value of 305 day milk yield corresponding to factor "calving interval", estimated by appropriate linear model, are recommended to be used for this purpose. Relations between these "means" and current calving interval for first three lactations are given in graph 1.

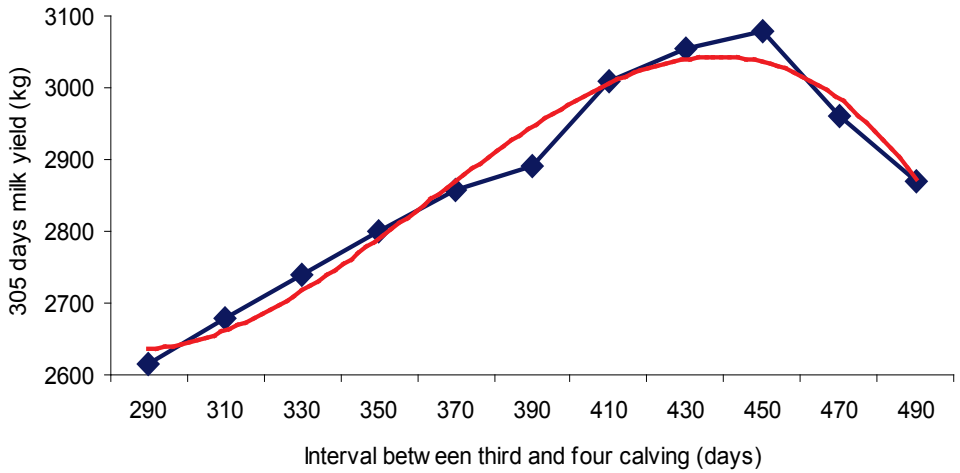
Graph 1. – RELATIONS BETWEEN LSM VALUE OF 305 DAY MILK YIELD AND LENGTH OF CURRENT CALVING INTERVAL IN FIRST LACTATION



Graph 2. – RELATIONS BETWEEN LSM VALUE OF 305 DAY MILK YIELD AND LENGTH OF CURRENT CALVING INTERVAL IN SECOND LACTATION



Graph 3. – RELATIONS BETWEEN LSM VALUE OF 305 DAY MILK YIELD AND LENGTH OF CURRENT CALVING INTERVAL IN THIRD LACTATION



Graph 1 to 3 shows that the lengthening of calving interval up to 420 days is associated with increase of 305 day milk yield for first lactation. For second lactation, increase of milk yield goes on as long as calving interval reaches 430 days and for third lactation up to 450 days. After these values, the further lengthening of calving interval is associated with the decrease of milk production converted 305 day milk yield of lactation. This situation is different from results published by other authors (Hanset, 1978; Leroy, 1980; Hansen et al., 1983; Jamrozik, 1997; Nebel, 2001).

It is due to two factors:

(i) cows have been managed under conditions of low input production system, which has influenced in lengthening days open;

(ii) intentional actions of farmer, who does not inseminate cow, lengthening calving interval in order that lactation reaches season where vegetation of the cultivated forages and spontaneous plants is very high.

Effect of the preceding calving interval is significantly proved for second lactation ($P<0.05$), although this effect is low. It only explains 2.67 % of 305 day milk yield for second lactation. Meanwhile, milk production of third lactation is not influenced by the length of preceding calving interval. This situation, which is avoided by them described by literature (Hanset, 1978; Leroy, 1980; Kume et al., 1990; Jamrozik, 1997; Nebel, 2001) could

be a consequence of small number of data that are analyzed. Results of analyze of variance carried out according to requests of model (2) are shown in table 5.

Table 5. – ANALYZE OF VARIANCE (MODEL 2)

Source of variance	m.s.*	F
Calving age	12.103	2.07*
Calving month	17.658	3.02*
Herd	27.779	4.751***
parity	5.689	0.973

* value must be multiplied by 10^4; * (P<0,05) *** (P<0,001)

The calving interval length is not conditioned by parity. Its value is influenced by calving age and season of calving (P<0.05), meanwhile, factor "herd" highly affects on this variance (P<0.001). This situation shows that role of farmer in the succession of reproductive processes is very important. To decide whether milk yield adjustment in order to reduce effect of calving interval has to be done or not, it is advisable that its stochastic correlation with factors "age of calving" and "month of calving" should be taken into consideration. Estimation of Pierson's correlation coefficients for first three lactations gave results shown in table 6.

Table 6. – ESTIMATION OF PIERSON'S CORRELATION COEFFICIENTS

	Calving interval		
	Lactation I	Lactation II	Lactation III
Age of calving	0.44*	0.41*	0.38*
Month of calving	0.62*	0.49*	0.51*

* (P<0.05)

Correlations between calving interval and calving age and month of calving are significantly proved (P<0.05) for three lactations. Under these conditions, it is logical to be studied what happen to effect of factor "calving interval" after adjusting 305 day milk yield for factors "calving age" and "month of calving". This adjustment of 305-day milk yield for first three lactations was carried out using multiplying factors, estimated for "Jersey" breed cows that have been managed under conditions of small scale family farms in Albania (Tahiri and Kume, 2008; Tahiri and Kume, 2009). Analyze of variance was carried out according to linear model (1) using the adjusted and unadjusted data (table 7).

Table 7. - ANALYZE OF VARIANCE – (MODEL 1)

Source of variance	Lact. I		Lact. II		Lact. III	
	F		F		F	
	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted
Calving age	0.85	2.09*	0.78	1.78*	0.64	0.72
Calving month	1.01	3.56**	0.99	2.15**	0.88	2.01*
Herd	3.86**	4.731***	2.76*	3.04**	2.39*	2.95**
Calving interval	1.98*	2.01*	1.13	1.96*	0.95	1.76*

* (P<0.05); ** (P<0.01); *** (P<0.001)

As seen, after adjusting 305 day milk yield to reduce effects of factors "calving age and month", effect of factor "current calving interval" continues to remain significantly proved (P<0.05) for first lactation only. As a consequence, adjustment 305 day milk yield in order to reduce effect of this interval on total variance of milk yield after previously adjusting to reduce effect of factors "age of calving and month of calving" should be done for first lactation, only. Methodology described by Tahiri (2008) was used to estimate adjusting factors. In accordance with this methodology, a regression function, as a third order polynom (3), was estimated using data of "least square" means for 305 day milk yield of first lactation, corresponding to factor "current calving interval" (table 8) assessed by linear model (1).

Table 8. – LEAST SQUARES MEANS FOR 305 DAY MILK YIELD OF FIRST LACTATION ESTIMATED BY LINEAR MODEL (1)

Calving interval (days)	Rank (x_i)	$\mu+l_i \pm s$	Calving interval (days)	Rank (x_i)	$\mu+l_i \pm s$
<290	1	2505±32	391-410	7	2865±30
291-310	2	2522±31	411-430	8	2910±34
311-330	3	2540±26	431-450	9	2855±28
331-350	4	2570±24	451-470	10	2740±31
351-370	5	2695±29	471-490	11	2705±26
371-390	6	2783±32	>490	12	2595±32

$$yi = 2453{,}63 + 23{,}408xi + 15{,}603xi2 - 1{,}532xi3 \quad (3)$$, where:

yi - average of 305 days milk yield corresponding of i-th calving interval
xi - rang of calving interval (xi=1, 12)

Using regression function (3), value of 305 day milk yield of first lactation, corresponding to each value of rang of calving interval, was computed. Computing of adjusting factors was made, using as the referent coefficient, equal to 1, the referring rank (5) of current calving interval (351-370 days):

$$ki = y5/yi \quad (i=1,12)$$

Table 9. – MULTIPLICATIVE ADJUSTING COEFFICIENTS (ki) CORRESPONDING TO LENGTH OF CURRENT INTERVAL BETWEEN FIRST AND SECOND CALVING

Calving interval (days)	Coefficient	Calving interval (days)	Coefficient
<290	1.1286	391-410	0.9877
291-310	1.1144	411-430	0.9826
311-330	1.0945	431-450	0.9792
331-350	1.0486	451-470	1.0060
351-370	1	471-490	1.0886
371-390	0.9968	>490	1.0971

Conclusion

Calving interval is non genetic factor that affects 305-day milk yield. Current calving interval shows significant influence ($p<0.05$ or $p<0.01$) on variance of milk production for first three lactations, meanwhile, preceding calving interval affects ($p<0.05$) milk production in first lactation, only.

Effect of this factor is markedly shown to cows that calve from July to October, as a consequence of farmer's intervention to lengthen days open in order that lactation extends during all the period of maximum vegetation of forage and spontaneous plants.

Relations between calving interval and milk production are developed according to rules that are in general, avoided by them given in literature. It is a consequence of production system effect that is applied in small scale family farm in Albania.

Multiplicative correction should be applied to reduce effect of calving interval on total phenotypic variance of 305 day milk yield in first lactation. Multiplicative coefficients are recommended to be used for this purpose.

Effect of calving interval on 305 day milk yield for second and third lactations is significantly eliminated if 305 days milk yield is adjusted for effects of factors "calving age" and "month of calving".

REFERENCES

1. Arbel, R., Y. Bigun, E. Erzan (2004): The effect of extended calving intervals in high lactating cows on milk production and profitability. Ministry of Agriculture, Dairy Production Department Israel (from internet).
2. Bicoku, Y. (1995): Gjedhi Holshtein ne Shqiperi. Probleme gjenetike dhe te pershtatjes, Disertacion per marrjen e grades shkencore.
3. Jamrozik, J., G. Jansen (1997): Persistency evaluations from the random regression model. Journal of Anim. Sci., p. 5.
4. Hansen, L.B, A.E. Freeman, P.J. Berger (1983): Variances, Repeatabilities and Age Adjustment of Yield and fertility in Dairy Cattle. Department of Animal Science, Iowa State University. ²Minnesota University. J. of Dairy Sci. Vol. 66, No. 2.
5. Hanset, R. (1978): Influence de certains facteurs non genetiques sur la production laitiere. Ann. Med. Vet. 122, 312-338.
6. Kume, K., M. Llukani, R. Tafaj, V. Dervishi (1989): Ndikimi i faktoreve jo gjenetike ne prodhimin e qumeshtit. Buletini i Shkencave Zooteknike dhe Veterinare 1, 34-42
7. Leroy, P., R. Hanset, A. Francois (1980): L`infuence de certains facteurs non genetiques sur la production laitiere. V. L`effet de l`intervalle de velage courant et de l`intervalle de velage precedant sur la production lairiere et la teneur en matieres grasse et en proteine en race Pie-Noire de Havre. Ann. Med. Vet. 123, 495-510.
8. Kume, K., F. Sula, I. Dema (1990): Konsiderata per treguesit kryesore te riprodhimit ne lope. Buletini i Shkencave Zooteknike dhe Veterinare (2), 45-51.
9. Nebel, R. (2001): What is the optimum calving interval. Journal of Dairy Science, Dairy Science Department, Virginia USA, J. Dairy Sci. p. 3. (from internet).
10. Tahiri, F. (2008): Vleresimi i ndikimit te faktoreve jo gjenetik ne variacionet e kurbes se lakatcionit dhe persistencave te saj ne lopet e races Xhersej ne Shqiperi. Disertacion per marrjen e grades shkencore.
11. Tahiri, F., K. Kume (2008): Study of 305 day Milk Yield for first three lactation of Jarsey cows under condition of small scale family farms I. Effects of calving age and season on total variance of milk yield. Jurnal of Tekirdag Agricultural Faculty 5(3), 283-290.
12. Tahiri, F., K. Kume (2009): Study of 305 day Milk Yield of Jersey cows under condition of small scale family farms II. Adjustment factors for 305 day milk yield. Jurnal of Tekirdag Agricultural Faculty 6(1), 31-36.

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