The impact of parity and lactation stage on initial milk flow

N. Livshin[1,2], E. Aizinbud[1,2] & E. Maltz[1]

[1]Agriculture Research Organization, Volcani Center, P.O. Box 6, Bet-Dagan 50250, Israel

[2]S.A.E. Afikim, kibbutz Afikim, Israel
E-mail: nicoll@volcani.agri.gov.il

Summary

In our previous studies it was established that milkings with low (<1 kg/min) initial flow, in average, are substantially less effective (in terms of milking time, peak flow etc.) in comparison to milkings of the same yield but with higher initial flow. The objective of this case study was to determine the proportion of "slow" and "fast-starters", in terms of initial milk flow rate, in relation to cows' parity and lactation stage. The study was performed at a commercial herd of 470 high productive Israeli Holstein cows milked trice daily. Milk flow parameters, including initial (0-15s) flow rate, have been monitored by Afiflo system (S.A.E Afikim, Israel). The data base comprised 5 consecutive days with about 7000 individual milkings. A cow was defined as slow-starter if it has 80% or more milkings with low initial flow. A cow with 20% or less milkings with low initial flow was defined as fast-starter. In first-calvers, in comparison to multiparous cows, the percent of slow-starters was significantly higher (51.2 vs. 31.1%), and percent of fast-starters – significantly lower (16.9 vs. 37.1%). The biggest difference in proportions of slow to fast start cows was recorded between first and second lactation. All fresh (DIM <30) primiparous cows, but only 31% from multiparous, were slow-starters. This proportion is declining for primiparous cows to 70.9% at 30-150 DIM and to 38.7% for cows later in lactation. In multiparous cows, the proportion of slow-starters was about the same for cows at different lactation stages.

We hypothesized that the higher percent of fast-starters in adult cows in comparison to first-calvers may be associated with age-related anatomical-physiological changes and also with better adaptation to milking procedure in adult cows. These results may contribute to definition of parity-related milk let-down traits. Substantial changes in proportions of slow- and fast-starters during lactation may alert on management- and equipment-related failures.

Key words: *Dairy cows, milk flow rate*

Introduction

There are only a few studies on effects of parity and lactation stage on particular parameters of milk let-down in dairy cows (e.g. Rothschild et al., 1980; Roth et al., 1998; Bagnato et al., 2003). Modern milk meters provide details on milk flow during each milking of each cow. For example, the Afiflo milk meter (S.A.E. Afikim, Israel) records flow rates in different time intervals, peak flow's rate and time, low flow time etc., leaving us with the problem how to exploit this data to improve management. This study deals with specific part of this information – initial (first 15s) milk flow rate. Previously it was established that milkings with low initial flow during the first 15 s are, in average, substantially less effective (in terms of milking time, peak flow etc.) in comparison to milkings of the same yield but with higher initial flow (Livshin et al. 2004, Maltz et al. 2004). We hypothesize that initial milk flow rate may be affected by cisternal milk yield increase and teat canal diameter enlargement with cow's aging, and also, in the long run, by harmful effect of machine milking on teat sphincters (Maltz et al., 2000, Devis et al., 2002). It was also supposed that at early lactation the initial milk flow rate in first-calvers may be inhibited because of incomplete adaptation to machine milking. Hence, the objective of this work was to study the possible effects of parity and lactation stage on initial milk flow rate.

Materials and methods

The study was performed in a commercial herd of 470 high productive (10500 kg per cow per lactation) Israeli Holstein cows, fed flat rate TMR. Cows were milked thrice daily in 2x14 herringbone parlor with standard prep routine (pre-dip and wipe). Milk flow parameters, including initial (0-15s) flow rate, have been monitored by Afiflo system (S.A.E Afikim, Israel). Data base comprised 5 consecutive days (15 milking sessions) in November 2003, with about 7000 individual milkings.

From the data base were excluded milkings: with multiple attachments, with yield less than 3 kg, of cows with less than 14 days in milk, and also milkings of cows that have less than 12 available milking data for this period. On the base of initial milk flow's level and stability, the cows were subdivided on slow-starters, fast starters, and intermediate group. A cow that had 80% or more milkings with low initial flow rate (less than 1 kg/min during first 15s) was defined as slow-starter. A cow that had 20% or less milkings with low initial flow rate was defined as fast-starter. The effects of lactation stage were determined for three periods: DIM <30, DIM 30-150, and DIM>150.

Results and discussion

The effects of parity.

During successive 15 milkings, about 70% of the cows were found to be either slow- or fast-starters (Table 1). This holds for primiparous, as well as multiparous cows, but in opposite proportions. In primiparous cows the slow-starters are the majority (51.2%) compare to 16.9% of fast starters, while among the multiparous cows were about equally distributed between slow- fasters, fast-starters and the intermidiate group (Table 1).

Table 1. Proportion of slow-starters[1] and fast-starters[2] among primiparous and multiparous cows. Data for 15 milkings during 5 successive days.

Lactation	Total	Slow-starters		Fast-starters		Intermediate group[3]	
	n	n	% of total	n	% of total	n	%of total
Primiparous	166	85	51.2	28	16.9	53	31.9
Multiparous	280	87	31.1	104	37.1	89	31.8

[1] Slow-starter - a cow that had 80% or more milkings with low initial flow rate (less than 1 kg/min during first 15s) in the 5d observation period.
[2]Fast-starter – a cow that had 20% or less milkings with low initial flow rate in the 5d observation period.
[3]Intermediate group includes cows that did not qualify as slow- or fast-starters.

The percent of fast-starters increased and the percent of slow starters decreased as lactation number advanced (Fig. 1). The biggest changes were recorded between first and second lactation. Changes were more moderate, however persistent thereafter. The proportion of the intermediate group remains quite constant.

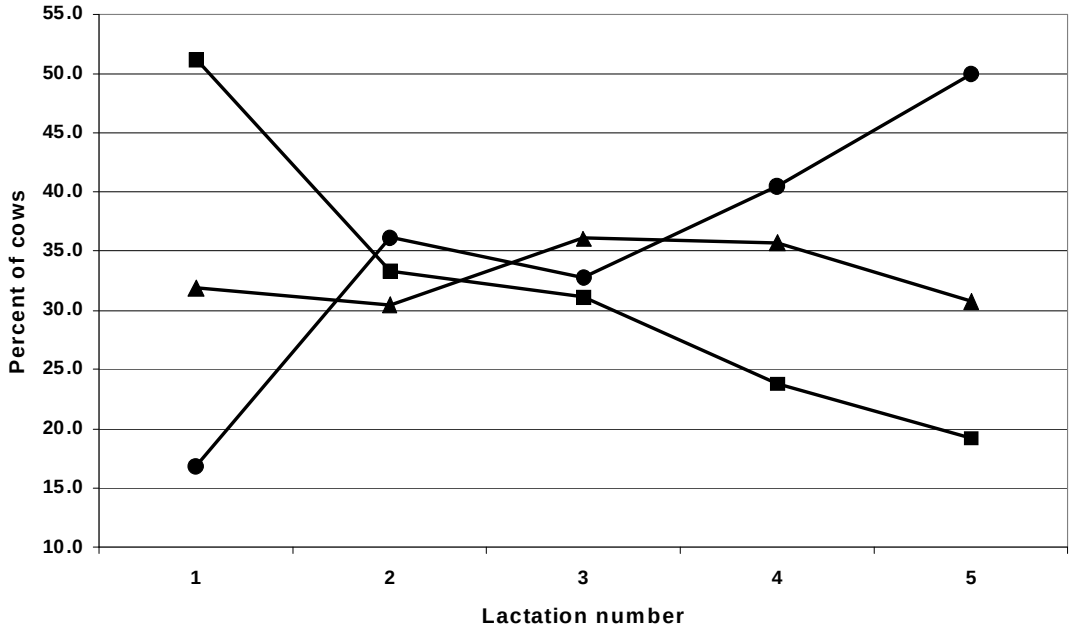

Figure 1. Proportion of slow starters (■– cows with at least 80% of milkings with milk flow < 1 kg/min during 0-15 sec) and fast starters (●-cows with less 20% or less milkings with milk flow < 1 kg/min during 0-15 sec), and intermediate starters (▲ - cows not included in the other two categories) in different lactations. Number of cows in each lactation: first – 166, *second – 141, third – 61, fourth – 42, fifth – 26.*

We suggest that rapid increase in proportion of fast-starters in second lactation may be related to enlargement of the teat diameter due to continuing animal's growth and effects of machine milking. The subsequent increase in fast-starters proportion may be attributed to lasting effect of machine milking on the teats. Remarkably, the additional increase in fast-starters proportion in fifth lactation cows was accompanied by significant decrease in mean milk flow rate (Table 2). It indicates that initial flow rate may characterize teat condition more precisely that average milk flow rate.

Table 2. Average milk flow rates: lactations' means (±SD) for all cows, slow starters and fast starters.

Lactation number	All cows		Slow starters[1]			Fast starters[1]		
				Mean flow rate			Mean flow rate	
	n	Mean flow, kg/min	n	kg/min	% to lactation mean	n	kg/min	% to lactation mean
1	166	2.02±0.49	85	1.73±0.32	85.5	28	2.64±0.41	130.6
2	41	2.32±0.61	47	1.99±0.64	85.7	51	2.64±0.57	113.7
3	61	2.33±0.47	19	2.10±0.36	90.1	20	2.59±0.51	111.2
4	42	2.38±0.60	10	1.84±0.41	77.3	17	2.64±0.56	110.8
5	26	2.03±0.69	5	1.44±0.57	71.1	13	2.37±0.55	116.4

[1]Slow-starter - a cow that had 80% or more milkings with low initial flow rate (less than 1 kg/min during first 15s) in the 5d observation period.
[2]Fast-starter – a cow that had 20% or less milkings with low initial flow rate in the 5d observation period.

The effects of lactation stage

During first lactation the proportion of slow and fast starters changes dramatically as lactation proceeds (Table 3). The later in lactation the more fast starters and less slow starters. In multiparous cows, the stage of lactation affected only the proportion of fast starters until 30 DIM. All fresh (DIM <30) primiparous cows, but only 31% from multiparous, were slow-starters. This proportion is declining for primiparous cows to 70.9% at 30-150 DIM and to 38.7% for cows later in lactation. In multiparous cows, the proportion of slow-starters was about the same for cows at different lactation stages. The proportion of fast- starters in primiparous cows increased from zero percent in fresh cows through 3.6% at DIM 30-150, to 24.5% afterward. The tendency of increased proportion of fast-start cows as lactation advances was found also in multiparous cows. These results apparently indicate that primiparous cows undergo rather prolonged adaptation to machine milking.

Table 3. Proportion of slow- , fast- and intermediate starters for primirarous and multiparous cows on different lactation stages. Data for 15 milkings during 5 successive days.

Cows' group	Period of lactation, days in milk					
	<30		30-150		>150	
	n	%	n	%	n	%
			Slow – starters[1]			
Primiparous	5	100	39	70.9	41	38.7
Multiparous	9	31.0	24	30.0	54	31.6
			Fast – starters[2]			
Primiparous	0	0	2	3.6	26	24.5
Multiparous	8	27.6	30	37.5	66	38.6
			Intermediate group			
Primiparous	0	0	14	25.5	39	36.8
Multiparous	12	41.4	26	32.5	51	29.8
			Total			
Primiparous	5	100.0	55	100.0	106	100.0
Multiparous	29	100.0	80	100.0	171	100.0

[1] Slow-starter - a cow that had 80% or more milkings with low initial flow rate (less than 1 kg/min during first 15s) in the 5d observation period.
[2]Fast-starter – a cow that had 20% or less milkings with low initial flow rate in the 5d observation period.
[3]Intermediate group includes cows that did not qualify as slow- or fast-starters.

In the future, it may be useful to establish the "normal" proportions of slow-starters and fast-starters in relation to parity and lactation stage under proper dairy management. Exceptional deviations or changes in these proportions may alert on management – or equipment-related failures.

In this work we did not follow cows' aging process, but extracted a snap-shot of a given situation in the dairy. However the analysis, similar to described above, was performed on the same 124 cows from that same dairy, once – as first-calvers and then after one year, in their second lactation. The proportions of slow- and fast-starters in these two lactations of the same cows were in accordance with this study results (unpublished data).

Conclusions

Cows can be characterized also by their initial milk flow rate. The proportion of slow-starters (cows with at least 80% of milkings with milk flow < 1 kg/min during 0-15 sec) decreases with each lactation number from 51.2% in first-calvers through 33.3% in second lactation and to 19.2% in 5 lactation. The proportion of fast starters (cows with less 20% or less milkings with milk flow < 1 kg/min during 0-15 sec) increases with lactation number, climbing from 16.9% in first lactation to 50% in the fifth. All fresh (DIM <30) primiparous cows, but only 31%

from multiparous, were slow-starters. This proportion is declining for primiparous cows to 70.9% at 30-150 DIM and to 38.7% for cows later in lactation. In multiparous cows, the proportion of slow-starters was about the same for cows at different lactation stages. The proportion of fast- starters in primiparous cows increased from zero percent in fresh cows through 3.6% at DIM 30-150, to 24.5% afterward. The tendency of increased proportion of fast-start cows as lactation advances was found also in multiparous cows.

The results obtained may contribute to understand parity- and lactation stage-related milk let-down traits. The anatomical, physiological and managerial factors behind the different levels of initial milk flow should be the subjects for future investigations. This variable (initial milk flow) may be incorporated in the future in selection programs.

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