

Live weight changes during lactation in Montbéliarde cows

Tomáš Kopec*, Gustav Chládek, David Jeník, Daniel Falta, Milan Večeřa
Mendel University in Brno, Faculty of AgriSciences, Department of Animal Breeding, Czech Republic

Article Details: Received: 2020-09-22 | Accepted: 2020-11-27 | Available online: 2021-01-31

<https://doi.org/10.15414/afz.2021.24.mi-prap.5-10>



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This research was conducted on 147 cows of purebred Montbéliarde dairy cattle during their first to seventh lactation. On average, each dairy cow provided 161 values on live weight during lactation via the automatic milking system (AMS). The average live weight of a dairy cow of said herd was 699.94 kg, the daily milk yield was 33.67 kg on average and the average day of lactation (DIM) was 111.75. This research discovered a statistically significant decrease of live weight in dairy cattle before the 60th day of lactation in every observed lactation. On the contrary, the changes in live weight in the last 60 days of standardized lactation proved to be inconclusive. Between days 60 and 240 of the lactation, an increase of live weight of varying intensities was observed, mainly in cows who had undergone less lactation cycles in the past. Similarly, the research has proven an impact of the number of lactation cycles the cow has undergone in the past on the live weight of the cow during the first, second and third lactation (645.21 kg, 700.35 kg and 752.10 kg respectively). On the contrary, there was no conclusive difference in live weight between the third and more lactation cycles. The results have also shown that the changes in live weight during lactation were significantly different in first-calf heifers, as opposed to cows after more lactation cycles, similarly to the differences in milk yield.

Keywords: Montbéliarde, dairy, body weight, lactation, cow

1 Introduction

The Montbéliarde breed is one of the significant dairy cattle breeds in the world. The Montbéliarde cows are bred in the Czech Republic as well, and their population is currently undergoing a dynamic development there. The increase of milk yield and efficiency is illustrated by the differences between newer and older data. For example, Chládek et al. (2000, 2001) describe a milk yield of 3,800 kg during the first lactation cycle, while data from the farm observed in this particular study describe a milk yield of 7,655 kg during the first lactation cycle. For this reason, it is important to observe the key elements of the high-production Montbéliarde dairy cattle management. One of such elements is the difference in live weight during lactation (Soyeurt et al., 2019). The development of live weight and its heredity, in this case particularly in the Nellore breed, was the area of study of Pores et al. (2020). To track the development of live weight, it is possible to use an automatic milking system (AMS) (Pszczola et al., 2018).

2 Material and methods

A total of 147 cows of currently milking animals from the ZD Libín farm in South Bohemian Region was observed. At the time of the research taking place (the first half of 2020), an average of 161 values on live weight and milk yield were collected from each cow. Thus, a total of 23,702 pieces of individual daytime live weight data was processed, as seen in Table 1. All the observed animals were purebred Montbéliarde breed dairy cows. According to the official data from a milk yield control, the average milk yield in cows during the first lactation cycle at the ZD Libín farm was 7,655 kg of milk, the average milk yield in cows during all lactation cycles was 8,809 kg of milk and the average age during the first calving was 788 days (26 months). The cows were stabled freely in no-bedding boxes. The feed composition was typical for the region (460 m a.s.l.) and its quantity was optimised via commercial nutrition software.

***Corresponding Author:** Tomáš Kopec, Mendel University in Brno, Faculty of AgriSciences, Department of Animal Breeding, Zemědělská 1, 613 00 Brno, Czech Republic; e-mail: tomas.kopec@mendelu.cz. ORCID: <https://orcid.org/0000-0003-2446-0952>

The data (milk yield, live weight) was obtained through AMS (Lely Astronaut). For the sake of our analysis, data from the 4th to 7th lactation cycles were merged into one group (Table 1). For the assessment of changes during lactation, data about live weight was divided into 10 sections, 30 days each (Table 4).

Table 1 Frequency of measurements per lactation

Order of lactation	Frequency	Percent
1	8,747	36.90
2	5,818	24.55
3	4,080	17.21
4–7	5,057	21.34
Sum	23,702	100.00

Collected data was statistically analysed. The dataset was analysed by the SAS statistical software. Significance of effects and differences between means were tested via the analysis of variance procedure PROC ANOVA (post hoc analysis using Tukey test). Statistical significance was tested at level of significance $\alpha = 0.05$. Procedure PROC REG was used for estimating of regressions coefficients.

3 Results and discussion

Our data, as presented in Table 2, shows that the average live weight of dairy cattle from the observed herd was 699.94 kg (standard deviation, *SD* 74.96 kg, coefficient of variability, *CV* 10.71%), the average daily milk yield was 33.67 kg (*SD* 8.02 kg, *CV* 23.83%) of milk and average day of lactation (DIM) was 111.75 (*SD* 80.78, *CV* 72.28%). These current figures on milk yield are almost twice as high as those stated by Chládek et al. (2001). The live weight of 699.94 kg is very similar to the number reported by Gruber et al. (2018) for the Fleckvieh breed – 702 kg. A lower average live weight of 654.9 kg is reported in the Holstein Friesian cattle by Toshniwal et al. (2008) and even lower live weight of around 540 kg was reported by Mlynek and Glowinska (2020) in the same breed in different stages of the lactation cycle.

Table 2 Means and variability of primary dataset

Variable	N	Mean	<i>SD</i>	<i>CV</i>
Body weight (kg)	23,702	699.94	74.96	10.71
Daily milk yield (kg)	23,702	33.67	8.02	23.83
Days in milk (days)	23,702	111.75	80.78	72.28

The changes in live weight and milk yield are depicted in detail in Figures 1–4. From the data collected we can observe that in all Figures an expected rapid increase of milk production takes place at the beginning of the lactation cycle, which is also accompanied by a distinct decrease in live weight. This happens regardless of the number of lactation cycle. This finding is in order with the findings stated by Soyeurt et al. (2019) and Alawneh et al. (2011). In their cases the decrease of live weight also culminated during the first two months of lactation.

Each of the Figures also shows a constant increase of live weight after the 60th day of lactation. This increase is more distinct mainly during the first, eventually the second lactation cycle, being the period in which the cow completes the physical development. This tendency is confirmed by Soyeurt et al. (2019) and Alawneh et al. (2011). Figures 1–4 also show that the development of live weight during lactation in first-calf heifers is distinctively different (both the increase and the decrease are more abrupt) from that in cows after more lactation cycles. Similar trends are described by Toshniwal et al. (2008) as well and they are similar to the trends in milk yield (Kopec et al., 2013).

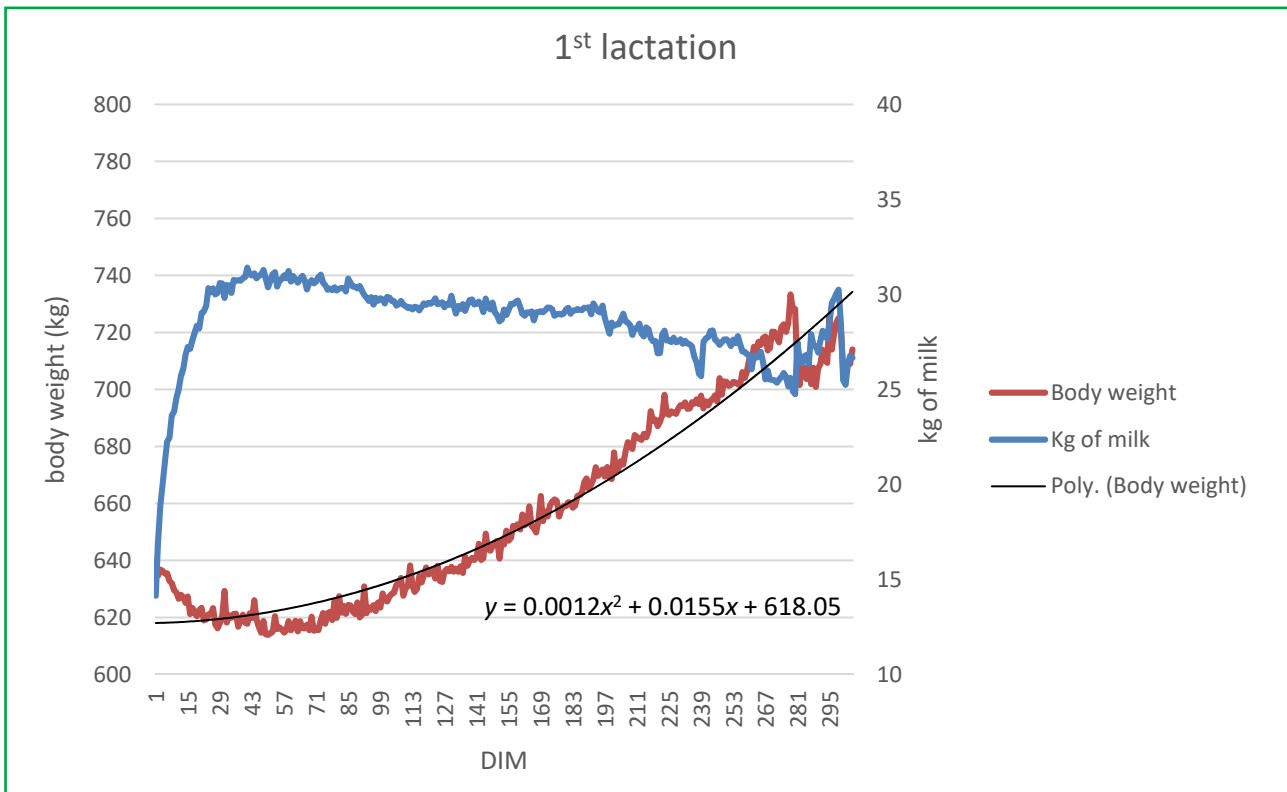


Figure 1 Course of milk yield and body weight during first lactation

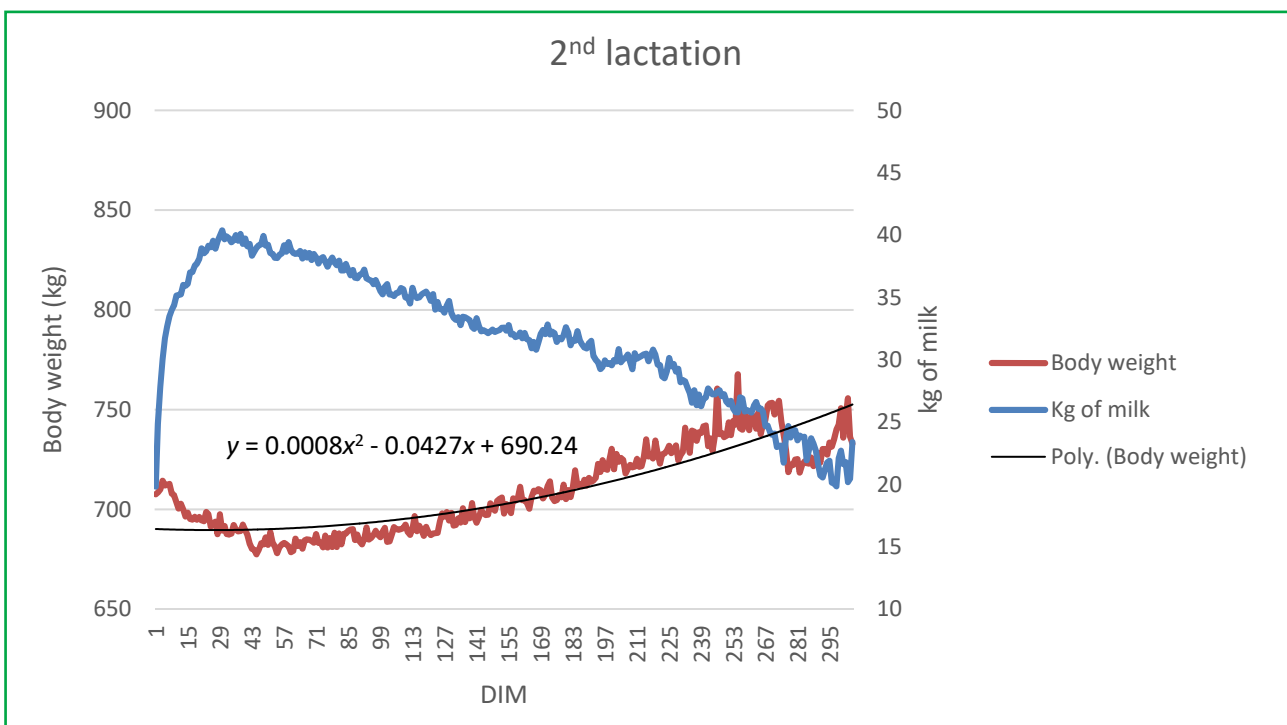


Figure 2 Course of milk yield and body weight during second lactation

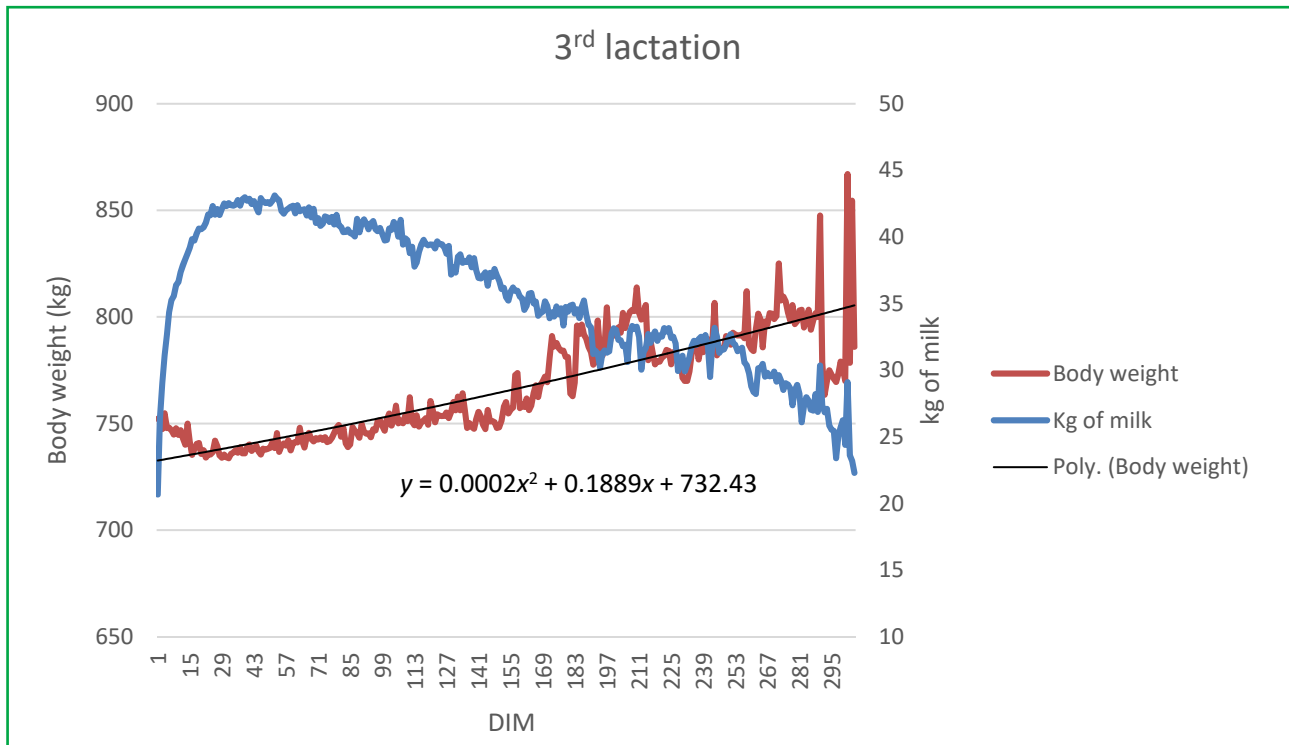


Figure 3 Course of milk yield and body weight during third lactation

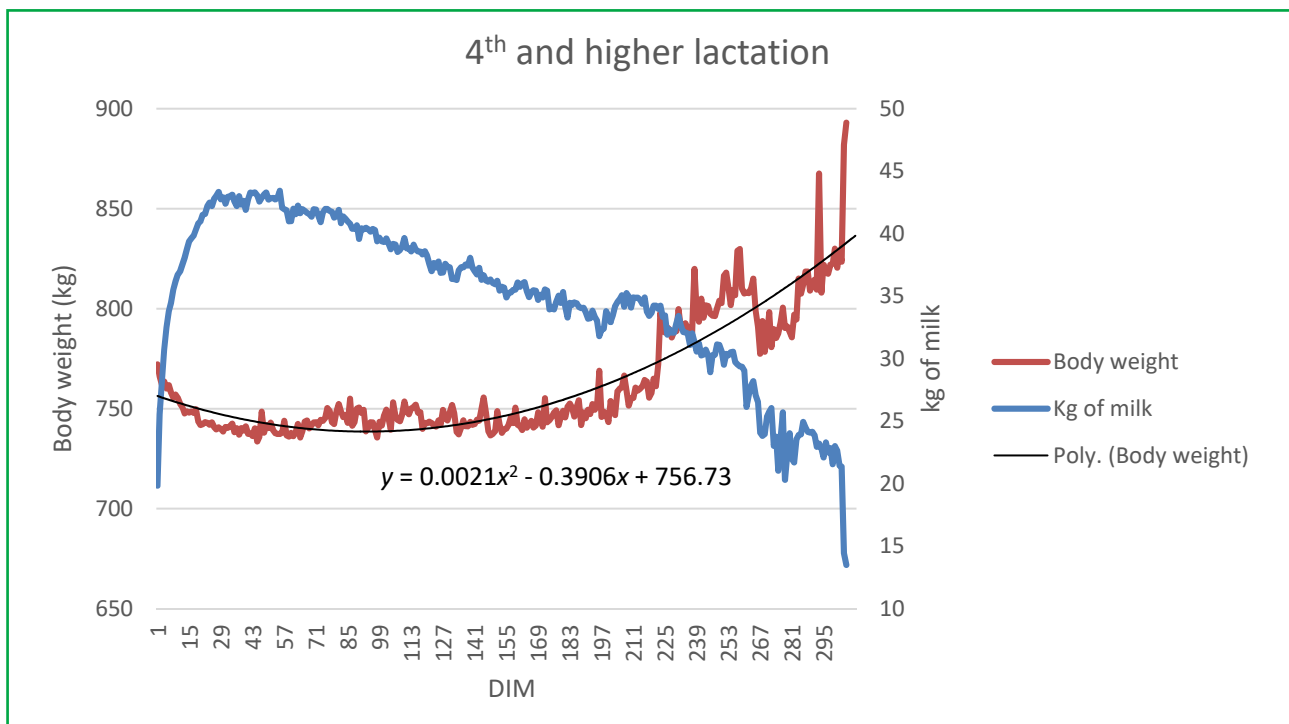


Figure 4 Course of milk yield and body weight during fourth and higher lactation

The data also show (Table 3) that the live weight maximum was reached at day 278 (733 kg) during the first lactation, day 255 (768 kg) during the second lactation, day 302 (867 kg) during the third lactation and day 305 (893 kg) during fourth and further lactations. The live weight minimum was reached at day 50 (614 kg) during the first lactation, day

45 (678 kg) during the second lactation, day 32 (734 kg) during the third lactation and day 45 (734 kg) during fourth and further lactations.

Table 3 Minimum and maximum values of body weight during lactation

Order of lactation	DIM	Min. BW (kg)	DIM	Max. BW (kg)
1	50.	614	278.	733
2	45.	678	255.	768
3	32.	734	302.	867
4 and higher	45.	734	305.	893

The numbers on live weigh minimum and maximum found out in this research correspond to the numbers described by other authors, for example Toshniwal et al. (2008), Soyeurt et al. (2019) or Alawneh et al. (2011).

Table 4 Differences between means of body weight on different parts of lactation (lact.)

DIM (days)	1 st lact.		2 nd lact.		3 rd lact		4 and higher lact.	
	mean	CV	mean	CV	mean	CV	mean	CV
1–30	626.21 ^a	7.07	700.65 ^a	8.57	742.07 ^a	7.81	750.38 ^a	9.45
31–60	618.51 ^b	7.31	684.73 ^b	8.08	738.15 ^b	7.46	739.28 ^b	7.81
61–90	620.01 ^{a,b}	7.19	684.73 ^b	7.66	743.71 ^{a,b}	7.78	744.41 ^{a,b}	7.49
91–120	628.93 ^a	7.42	688.58 ^{b,c}	7.39	750.66 ^a	8.51	745.25 ^{a,b}	7.44
121–150	639.30 ^c	7.77	695.74 ^{a,c}	7.02	753.32 ^{a,c}	9.04	743.63 ^{a,b}	6.56
151–180	653.84 ^d	8.21	705.93 ^a	7.06	767.22 ^{c,d}	9.75	744.04 ^{a,b}	6.65
181–210	669.75 ^e	7.90	718.36 ^e	7.26	789.44 ^e	9.72	751.53 ^a	7.78
211–240	690.87 ^f	8.30	730.15 ^{e,f}	6.79	784.37 ^{e,d}	9.62	777.30 ^c	8.30
241–270	705.35 ^g	8.57	743.17 ^f	7.02	792.21 ^e	9.93	804.01 ^d	8.72
271–305	715.72 ^g	8.25	733.44 ^f	8.08	797.85 ^e	11.07	807.04 ^d	7.55

Means with different letters are significantly different at the $P < 0.05$ within lactation

Table 4 shows the average data on cattle live weight during different stages of the lactation cycle. Through this data we can observe a statistically significant decrease of live weight in the dairy cattle up until day 60 of lactation. On the contrary, the changes in live weight during the last 60 days of standardized lactation proved to be inconclusive. Between days 60 and 240 of the lactation, an increase of live weight of varying intensities was observed, mainly in cows who had undergone less lactation cycles in the past. An initial decrease along with the subsequent increase of live weight in different stages of lactation, similar to the data collected in this research, is observed by Mlynek and Glowinska (2020). Similar trend was also documented by Toshniwal et al. (2008) and Soyeurt et al. (2019).

Table 5 Differences between lactations in body weight

Order of lactation	Mean (kg)	CV (%)
1	645.21 ^a	8.95
2	700.35 ^b	8.02
3	752.10 ^c	8.76
4 and higher	749.55 ^c	8.15

Means with different letters are significantly different at the $P < 0.05$

This research has observed a conclusive impact of the number of lactation cycle on the dairy cattle live weight (Table 5), mainly during the first, second and third lactation (645.21 kg, 700.35 kg and 752.10 kg respectively). However, no significant change in live weight was measured between the third and further lactation cycles. The trend of live weight increasing with every lactation cycle was, according to Ledinek et al. (2019), apparent from the 649 kg during first lactation to the 744 kg during the fifth and further lactations.

4 Conclusions

The changes in live weight during lactation can be used in dairy management. To observe the development in live weight, this research used automatic data collection via AMS. The observed herd of dairy cattle had the average live weight of 699.94 kg per cow, the average daily milk yield of 33.67 kg of milk per cow and the average day of lactation was 111.75. Based on the data collected, we can state that we observed a significant decrease of live weight up until the 60th day of the lactation cycle. On the contrary, the changes in live weight in the last 60 days of lactation proved to be always statistically inconclusive. Between days 60 and 240 of the lactation, an increase of live weight of varying intensities was observed, mainly in cows who had undergone less lactation cycles in the past. Similarly, the research proved an influence of the number of lactation cycles the cow had undergone in the past on its live weight. In cows going through the first three lactation cycles, the overall live weight increased with each new lactation cycle. No significant increase of live weight has been proven between the third and further lactation cycles. The data collected shows that the physical development in high-production dairy cattle continues even during the third lactation, which we propose should be taken into consideration during optimisation of their breeding management.

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