

REPRODUCTIVE PERFORMANCE PARAMETERS OF HOLSTEIN FRIESIAN COWS PRIOR TO TWIN-CALVING

ARI MELINDA – EBMEYER CLAUDIA – VINCZE BOGLÁRKA – GULYÁS LÁSZLÓ –
GÁSPÁRDY ANDRÁS

SUMMARY

The occurrence of twin-calving in the Holstein Friesian cattle breed is between 3-5%. In large-scale farming, the reproductive problems around and after the time of calving, like higher mortality of the progenies and the involuntary culling can cause serious economic losses. The aim was to analyse and compare the reproductive performances before calving of cows with twins and single calves. There has not been any significant difference between the values of ages at first breeding, at first conception or at first calving. For the calving to service interval before the actual calving no significant differences have been found between the two cow groups. Significant difference has been found in the length of open days before calving. This period of time was shorter in twinning cows than in cows with single birth before calving. Those cows that had twins became pregnant easier and more successfully, probably because of their better health and reproductive status. Their gestation period was shorter as well, and their calving interval was more favourable (shorter) too. As future twin-calving cows needed less time for regeneration, shown more successful conception (those cows also had shorter open days period), moreover, their gestation period was shorter than cows with single birth. The complexity of these factors resulted in shorter calving intervals in twiners. According twin-calving cows were definitely in better health- and reproductive status prior to calving.

ÖSSZEFOGLALÁS

Ari, M. – Ebmeyer, C. – Vincze, B. – Gulyás, L. – Gáspárdy, A.: AZ ELLÉST MEGELŐZŐ IDŐSZAK SZAPORODÁSI MUTATÓINAK ALAKULÁSA IKERBORJAS HOLSTEIN-FRÍZ TEHENEKBN

A holstein-fríz szarvasmarhánál az ikerellések előfordulása 3-5% közé tehető. Nagy létszámú gazdaságokban az ellés körüli és utáni szaporodásbiológia problémák, valamint a borjak gyakoribb elhullása és a tehének selejtezése komoly gazdasági károkat okozhatnak. A szerzők célja az volt, hogy elemezzék az ikret ellő anyák szaporodásbiológiai eredményeit az adott ikerellést megelőző időszakokban az egyet ellő társaik értékeihez viszonyítva. A tenyésztésbevételi-, első vemhesülési-, és az első ellési életkorokban nem tapasztaltak szignifikáns eltérést. Az ellést megelőző pihenési időszakban sem kaptak igazolható eltérést a két csoport egyedei között. Az üresenállás hosszában már statisztikailag igazolt eltérést találtak. Az ikret ellő anyák ellését megelőzően ez az időszak rövidebbnek bizonyult. Ezek a tehének könnyebben és sikeresebben vemhesültek, vélhetően jobb egészségi és szaporodásbiológiai állapotúak voltak. A vemhességi ideje az ikret ellő anyáknak rövidebb volt. A két ellés közti időszak szintén rövidebb, így kedvezőbb is volt az ikret ellő anyáknál. Mivel az ikret ellő anyáknak kevesebb időre volt szükségük a regenerálódáshoz, eredményesebben termékenyültek (az üresenállási idejük is rövidebb volt), valamint a vemhességi idejük is rövidebbnek bizonyult. Ezek összessége eredményezte számukra a rövidebb két ellés közti időt. Eredményeik azt mutatják, hogy az ikret ellő tehének az ellésüket megelőzően minden bizonnyal jobb egészségi és szaporodásbiológiai állapotban voltak. Ennek folyamánya a korábban bekövetkező sikeres ikervemhesség. A továbbiakban vizsgálatainkat a tejtermeléssel és a kondíciópontokkal is alá kívánjuk támasztani.

INTRODUCTION

Investigations on bovine twin-calving were firstly published in the early 1900's. Both breeders and experts were interested in the phenomenon that a basically uniparous animal can give birth to two or more healthy progenies.

In the 1930's *Kronacher* was the first who highlighted one of the most important aims of twin-calving researches: raising identical calves under experimentally different conditions (cit. *Csukás*, 1949). From an economical viewpoint, the excess number of calves per calving would also be advantageous.

Nevertheless, twin-calving has several negative consequences. Abortion (*Nielen et al.*, 1989), dystocia (*Cady and Van Vleck*, 1978), higher mortality of the calves around or during parturition (*Johansson et al.*, 1974) and placenta retention (*Szelényi et al.*, 2009) are more frequent in twin-calving cases. Twins are less developed than their same age single-born mates, have higher mortality rate (*Silva de Ró et al.*, 2007) and breeding can be started later (*Ari*, 2010). Use of sex-sorted semen results in a lower twin frequency (*Djedović et al.*, 2016). This lower twinning rate is due to damages caused to spermatozoa by the physical forces during the sexing process.

In case of twins with different sex (bull and heifer), in 98% of all cases heifers are not suitable for breeding because of freemartinism (*Fésüs*, 2004).

The bad reproductive biological consequences of twin-calving are well known. Therefore, our research aimed at the question how much benefit might result in reproductive biological factors before calving.

MATERIAL AND METHOD

Data from a North Hungarian dairy farm have been analysed. Reproduction data of almost 4000 cows that calved between 2000 and 2010 and are already culled out have been used. In heifers we have compared the following attributes: the age at first breeding, the age at first conception, and the age at first calving. After reclassification of the individuals because of ageing, in the cow's life, we analysed the calving to service period, the open days, the length of gestation, and the calving interval prior to given calving.

The reproductive traits were determined as follows; *age at first breeding*: described as a difference between the date of first insemination and date of birth, *age at first conception*: described as a difference between the date of first successful insemination and date of birth, and the *age at first calving*: described as a difference between the date of first calving and date of birth. The *calving to service period* referred to the period of time being between the calving and the very first re-breeding (calculated as a difference between the date of first insemination and the date of calving), the *open days* was understood as a period of time being between the calving and the conception (calculated as a difference between the date of successful insemination and the date of calving), the *length of gestation* meant the period of time counted from the date of delivery and the date of conception, and the *calving interval* was calculated based on the date of actual calving (resulted in single calf or twins) and the date of previous calving.

As none of the analysed periods showed normal distribution (Shapiro-Wilk W

test p-value was greater than 0.05 for each trait), we applied natural logarithm transformation for normalizing them (trait $\rightarrow$ eLOGtrait). The log-transformed reproduction traits were processed by general linear models (GLM). In the selected single trait models the following effects were considered for heifer's traits: type of calving (single or twin), and the construction code which refers to blood proportion of the Holstein Friesian (HF) breed (221 $\geq 96.88\%$; 222 $\geq 93.75\%$ and $< 96.88\%$; 223 $\geq 87.5\%$ and $< 93.75\%$; 224 $\geq 75\%$ and $< 87.5\%$; 225 $\geq 50\%$ and $< 75\%$; the upgrading procedure have mostly started on Hungarian Simmental basis). Furthermore, in cow age, besides type of calving and construction code the number of lactation (calving), the season of calving, the sex of the calf as fixed effects while the birth weight of the calves as covariate were considered. The differences were tested using Tukey's post hoc method. By use of analysis of variance we also calculated the variance component estimates that will also be presented.

The results are published as geometric means after back transformation (BACKtrait $\leftarrow$ eLOGtrait). Additionally, we present their lower and upper confidence limits of 95% (that are about twice the standard deviation) instead of standard deviation which can be misleading in such cases.

Statistica ver. 13. (Dell Inc., 2015) program was used for the preparation of the database and data processing.

RESULTS AND DISCUSSION

In the beginning of our analyses we compared the ages at first breeding, at first conception and at first calving of twinning and non-twinning cattle. We have not found significant difference ($p=0.753$) in the age at first breeding between twinning and non-twinning heifers (Table .1). This stems from similar housing- and nutrition technology of the heifers' raising. Their age at first breeding is management-related; it depends on which developmental stage they are at. The age at first breeding at the farm was 17.909 months (which refers to 544 days) on average. The value of age at first breeding is acceptable (however, we mention that there is no data for this trait at national level).

However, the age at first breeding show remarkable ($p<0.05$) differences according to the construction code. As the HF blood proportion increased, the age at first breeding became gradually shorter. Results confirmed that HF is an early mature type of cattle. The construction code was responsible for the variance at the largest extent ($p<0.001$; 96.62%).

It can be seen in Table 2. that the average age at first conception was 18.338 months (557 days). We did not found statistically proven ($p=0.868$) differences between the ages of the non-twinning and twinning heifers. Results show that heifers became pregnant by the 13th day of service on average. This performance can occur under such condition when the very first or the second insemination is already mostly successful.

At the same time, results according to construction code (with a variance components of 83.61%) reveal the significantly ($p<0.05$) better fertility of heifers with higher HF blood proportion as well.

Table 1.

Age at first breeding (month)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving (p = 0.753; 0.30%) (6)				
- Non-twinning heifers (7)	3569	17.74	17.88	18.03
- Twinning heifers (8)	392	17.69	17.92	18.14
Construction code (p < 0.001; 96.62%) (9)				
221	2780	16.99	17.09 ^a	17.20
222	655	17.37	17.53 ^b	17.69
223	334	17.47	17.68 ^b	17.90
224	150	17.88	18.20 ^c	18.53
225	42	18.45	19.06 ^c	19.69
Error (3.07%) (10)				
Overall mean (11)	3961		17.91	

a,b,c – different letters mean significant (p < 0.05) differences (Tukey's post-hoc test) (12)

1. táblázat Tenyésztésbevételei életkor (hónap)

Hatás (p-érték és varianciarányad) (1); Megfigyelések száma (2); Alsó 95%-os konfidencia határ (3); Geometriai átlag (4); Felső 95%-os konfidencia határ (5); Ellés típusa (6); Egyet ellő üsző (7); Ikret ellő üsző (8); Konstruktív kód (9); Hiba (10); Főátlag (11)

a,b,c – a különböző betűk szignifikáns (p < 0,05) különbségeket mutatnak (Tukey-féle post hoc teszt) (12)

Table 2.

Age at first conception (month)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving (p = 0.868; 0.44%) (6)				
- Non-twinning heifers (7)	3410	18.15	18.32	18.50
- Twinning heifers (8)	376	18.08	18.34	18.62
Construction code (p < 0.001; 83.61%) (9)				
221	2652	17.80	17.99 ^a	18.06
222	630	17.78	17.97 ^a	18.17
223	315	17.84	18.10 ^a	18.37
224	148	18.03	18.41 ^{ab}	18.79
225	41	18.58	19.30 ^b	20.04
Error (15.96%) (10)				
Overall mean (11)	3786		18.34	

a,b – different letters mean significant (p < 0.05) differences (Tukey's post-hoc test) (12)

2. táblázat Első vemhesülési életkor (hónap)

(1)-től (11)-ig lásd 1. táblázat

,b – a különböző betűk szignifikáns (p < 0,05) különbségeket mutatnak (Tukey-féle post hoc teszt) (12)

The pregnant heifers reached their first calving at age of 27.463 month on average (*Table 3.*). There was no significant difference ($p = 0.830$) between either, the twinning and non-twinning heifers' results. The national average of age at first calving varies between 26.25 and 28.35 months for the 221-225 construction code Holstein Friesian breed (*NÉBIH*, 2000-2015). The age at first calving on the analysed farm equals to the national average in this respect.

Like before, the construction code had the largest impact among the effects investigated on the reproductive feature of heifers ($p < 0.001$; with a variance component of 84.88%). Further on, there were significant differences ($p < 0.05$) among them in the age at first calving.

The length of the calving to service period, prior to given calving was 73.916 days on average (*Table 4.*). There was no difference between twinning and non-twinning cattle. Relevant literature defines the first time of insemination after calving between 70-90 days, so this result is deemed to be real. It is worth ascertaining that the first true oestrous of cows

Table 3.

Age at first calving (month)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving ($p = 0.830$; 0.67%) (6)				
- Non-twinning heifers (7)	3632	27.27	27.45	27.62
- Twinning heifers (8)	395	27.20	27.47	27.75
Construction code ($p < 0.001$; 84.88%) (9)				
221	2832	26.91	27.04 ^a	27.17
222	662	26.86	27.05 ^{ab}	27.25
223	340	26.93	27.19 ^{ab}	27.45
224	151	27.19	27.57 ^{bc}	27.96
225	42	27.76	28.48 ^c	29.22
Error (14.46%) (10)				
Overall mean (11)	3786		27.46	

a,b,c – different letters mean significant ($p < 0.05$) differences (Tukey's post-hoc test) (12)

3. táblázat Első ellési életkor (hónap)

(1)-től (12)-ig lásd 1. táblázat

without calving complications occurred in days 30-50 and all of them should be inseminated at least once within 100 days postpartum.

Instead of the construction code the season of the calving had significant impact on this reproductive feature. Cows calved during fall had the shortest and most favourable value in the postpartum rest period (71.379; $p = 0.002$).

While the birth weight of the calves contributed to total variance at the largest degree ($p < 0.001$; 59.92%). The strong connection between the birth weight

Table 4.

Calving to service period before given calving (days)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving (p= 1.000; 0.00%) (6)				
- Non-twinning cows (7)	6208	72.40	73.90	75.44
- Twinning cows (8)	722	71.13	73.92	76.81
Construction code (p= 0.273; 6.11%) (9)				
221	4305	73.59	75.20	76.85
222	1340	71.02	73.09	75.21
223	742	71.42	74.09	76.89
224	379	69.18	72.64	76.27
225	164	69.18	74.56	80.37
Calving season (p= 0.002; 23.83%) (10)				
Winter (11)	1787	71.88	74.12 ^{ab}	76.43
Spring (12)	1260	73.34	75.83 ^b	78.39
Summer (13)	1945	72.22	74.39 ^b	76.62
Autumn (14)	1958	69.26	71.38 ^a	73.57
Lactation (p= 0.528; 3.52%) (15)				
2.	2982	71.86	73.95	76.11
3.	1911	70.68	72.85	75.09
4.	1052	71.82	74.36	76.98
5. and more	985	71.97	74.49	77.10
Sex of the calf (p= 0.531; 1.87%) (16)				
Bull (17)	3597	71.74	73.65	75.62
Heifer (18)	3333	72.20	74.17	76.19
Birth weight (p< 0.001; 59.92%) (19)			-3.46*	
Error (4.75%) (20)				
Overall mean (21)	6930		73.92	

a, b, c – different letters mean significant (p< 0.05) differences (Tukey's post-hoc test) (22)

* – regression coefficient – regressziós együttható

4. táblázat Az ellést megelőző pihenési időszak hossza (nap)

(1)-től (9)-ig lásd 1. táblázat; Ellési évszak (10); Tél (11); Tavasz (12); Nyár (13); Ősz (14); Ellés sorszáma (15); Borjú ivara (16); Bika (17); Üsző (18); Születéskori súly (19); Hiba (20); Főátlag (21)

a, b, c – a különböző betűk szignifikáns (p< 0,05) különbségeket mutatnak (Tukey-féle post hoc teszt) (22)

and the calving to service period tells us that the cows which required a shorter post-partum re-breeding period (shorter involution may also be included) tend to produce heavier foetus.

The open days before calving are shown in *Table 5*. Their average on the observed farm was 106.958 days (by 33 days longer than the calving to service period), and a statistically proven difference was found between twinning and non-twinning cows ($p=0.047$). The open period was 109.246 days for non-twinning and 104.587 for twin-calving cows. These values mean that twin-calving cows required a shorter service period by 4-5 days than non-twinning cows, which is the result of their better chance for conception.

Although these cattle were produced under the same housing and feeding conditions as their cow mates, we assume a better body condition status of twinning-cattle which also meant better reproductive biology characteristics.

The significant contribution of the effects (each p -value less than 0.05) to the total variance happened to be as follows: calving season, construction code, birth weight, type of calving, and number of lactation (42.15%, 19.53%, 18.59%, 8.71%, and 8.04%, respectively). Cows with a calving in autumn and with lower HF blood proportion than others spent shorter time in their non-pregnant period.

Table 6. presents the length of gestation before calving on the studied farm. The average length of this period of time was 276.317 days. Here we experienced significant ($p<0.001$) difference of approximately 5 days by type of calving. Twin-calving cows' gestation length (273.956 days) has proven to be shorter than that of non-twinning (278.694 days) herd-mates.

It is worth mentioning as it is quite remarkable, the determination of gestation length by the type of calving- alongside the gender of calf and season of calving. In this reproductive trait we found the largest variance component values for them (type of calving, calf sex, and season of calving 64.22%, 17.32%, and 10.92%, respectively).

Heifer calves were born about 1 day earlier than bull calves ($p<0.001$), and the summer calving was related to the shortest gestation length ($p<0.001$).

The calving interval is ideal when it is as close to 365 days as possible. Unsatisfactorily, the length of calving interval exceeds 420 days the Hungarian Holstein Friesian population. The national average of this breed is between 425-444 days (*NÉBIH*, 2000-2015). The estimated calving interval on the farm observed was 398.176 days. Comparing the farm value to the national average this result is favourable (*Table 7*). Significant difference ($p<0.001$) was observed between the twinning and non-twinning cows. The calving interval in twin-calving cows was shorter (392.164 days) by 12.062 days than that in non-twinning cows (404.226 days).

The type- and season of calving shared equally (32.20% and 30.02%, respectively; each p -value was less than 0.001) the almost two thirds of total variance. The birth weight and calving season are among the effects taken into consideration and were also significantly attributable to calving interval (with variance components of 14.72% and 14.09%, respectively).

Table 5.

Open days before calving (days)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving ($p = 0.047$; 8.71%) (6)				
- Non-twinning cows (7)	5318	106.78	109.25 ^b	111.77
- Twinning cows (8)	642	100.19	104.59 ^a	109.18
Construction code ($p < 0.001$; 19.53%) (9)				
221	3596	111.75	114.55 ^a	117.41
222	1184	102.75	106.12 ^b	109.61
223	675	101.89	106.11 ^b	110.51
224	351	101.09	106.66 ^b	112.54
225	154	93.40	101.43 ^{ab}	110.15
Calving season ($p < 0.001$; 42.15%) (10)				
Winter (11)	1568	103.50	107.10 ^b	110.83
Spring (12)	1060	111.75	116.03 ^c	120.46
Summer (13)	1669	101.10	104.50 ^{ab}	108.02
Autumn (14)	1663	97.19	100.53 ^a	103.99
Lactation ($p < 0.012$; 8.04%) (15)				
2.	2521	100.48	103.76 ^a	107.15
3.	1635	104.79	108.39 ^b	112.12
4.	911	102.31	106.39 ^{ab}	110.63
5. and more	893	105.03	109.11 ^{ab}	113.36
Sex of the calf ($p < 0.551$; 0.78%) (16)				
Bull (17)	3060	104.20	107.30	110.50
Heifer (18)	2900	103.35	106.49	109.72
Birth weight ($p < 0.004$; 18.59%) (19)			-2.428*	
Error (2.20%) (20)				
Overall mean (21)	5960		106.96	

a, b – different letters mean significant ($p < 0.05$) differences (Tukey's post-hoc test) (22)

* – regression coefficient – regressziós együttható

5. táblázat Az ellést megelőző üresenállás hossza (nap)

(1)-től (21)-ig lásd 4. táblázat

a, b – a különböző betűk szignifikáns ($p < 0,05$) különbségeket mutatnak (Tukey-féle post hoc teszt) (22)

Table 6.

Length of gestation before calving (days)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving ($p < 0.001$; 64.22%) (6)				
- Non-twinning cows (7)	9940	278.50	278.69 ^b	278.89
- Twinning cows (8)	724	273.56	273.96 ^a	274.35
Construction code ($p = 0.053$; 0.27%) (9)				
221	6911	275.99	276.21 ^a	276.42
222	1954	275.75	276.02 ^a	276.29
223	1056	275.79	276.13 ^a	276.47
224	521	275.66	276.12 ^a	276.57
225	222	276.39	277.11 ^b	277.82
Calving season ($p < 0.001$; 10.92%) (10)				
Winter (11)	2818	277.02	277.31 ^c	277.60
Spring (12)	2156	276.25	276.55 ^b	276.86
Summer (13)	2779	274.82	275.11 ^a	275.39
Autumn (14)	2911	276.01	276.30 ^b	276.59
Lactation ($p < 0.001$; 7.12%) (15)				
1.	3786	274.69	274.98 ^a	275.28
2.	2985	275.88	276.17 ^b	276.46
3.	1882	276.35	276.65 ^{bc}	276.97
4.	1033	276.44	276.80 ^{bc}	277.16
5. and more	978	276.61	276.98 ^c	277.34
Sex of the calf ($p < 0.001$; 17.32%) (16)				
Bull (17)	5436	276.65	276.90 ^b	277.16
Heifer (18)	5228	275.47	275.73 ^a	275.99
Birth weight ($p = 0.593$; 0.03%) (19)			0.112 [*]	
Error (0.12%) (20)				
Overall mean (21)	10664		276.32	

a, b, c – different letters mean significant ($p < 0.05$) differences (Tukey's post-hoc test) (22)

* – regression coefficient – regressziós együttható

6. táblázat Az ellést megelőző vemhesség hossza (nap)

(1)-től (21)-ig lásd 4. táblázat

a, b, c – a különböző betűk szignifikáns ($p < 0,05$) különbségeket mutatnak (Tukey-féle post hoc teszt) (22)

Cows giving birth in autumn especially to a heavier calf, and are still carrying more blood of the initial local breed were characterized by shorter calving interval than others.

CONCLUSIONS

Results on heifers' performances show that there is no difference in age at first breeding, first conception and first calving between non-twinning and twinning individuals.

Since the start of breeding depends on breeders' decision which is the same for every young growing animals. However, we observed considerable differences in the length of open days, gestation, and calving interval during the herd life. In the first part of our investigation we dealt with trait occurred only once on the course of heifer's life, while in the following section we analysed traits occurring repeatedly more than once in the life of a cow, but in all cases those were taken into consideration before calving. Although all cattle produced under the same housing and feeding circumstances, we assume a better body condition status of twinning-cattle which also meant better reproductive biology characteristics. It would have been worth confirming our results by using cow condition scores (but records on body condition score are available in the farm database since the last 3 years only).

In our retrospective study we revealed specific causal connections between the influencing effects and the reproductive traits investigated. For example, in the case of twin-calving cows we found better results in the open days before calving. The difference between twin-calving and non-twinning cows was more than 4 days. The twin calving – of course – cannot determine the number of open days – especially not backwards, but the significant connection being between them allows us to conclude that those cows will give birth to twins which have required shorter time for re-conception than others because of their better actual physical conditions.

The results – being somewhat controversial – revealed that most favourable reproductive values could be observed in those cows which calved during the autumn, and not in summer when the frequency of twinning itself is elevated (*Ari et al.*, 2016). One possible cause of both phenomena can be in the beginning of the 3rd season, during the fall and winter months, when the summer heat stress is over and the weather is newly colder get the individuals into the more fertile period of the whole year.

Twin-calving cows' gestation length has proven to be shorter than that of non-twinning herd-mates. Other studies confirm our results where authors (*Nielen et al.*, 1989, by 6 days; *Szelényi et al.*, 2009, by 4-8 days; *Olson et al.*, 2009, by 6 days) measured shorter gestation period in favour of twinning cattle. The length of gestation is partly breed specific but twin-calving cattle' gestations are shorter presumably because of the bigger total weight of foetuses.

Significant difference was observed between the twinning and non-twinning cows in the calving interval too. The calving interval in twin-calving cows was shorter by 12 days than that in non-twinning cows which in fact is – over and above – rather advantageous. Twin-calving cows' length of gestation is also shorter by nearly 5 days.

Table 7.

Calving interval (days)

Effect (p-value and variance components) (1)	Number of observations (2)	Lower confidence limit of 95% (3)	Geometric mean (4)	Upper confidence limit of 95% (5)
Type of calving ($p < 0.001$; 32.20%) (6)				
- Non-twinning cows (7)	5698	401.44	404.23 ^b	407.03
- Twinning cows (8)	680	387.12	392.16 ^a	397.28
Construction code ($p < 0.001$; 14.09%) (9)				
221	3877	403.66	406.66 ^b	409.68
222	1262	393.86	397.69 ^a	401.57
223	710	392.00	396.85 ^a	401.75
224	363	389.26	395.68 ^a	402.20
225	166	384.29	394.00 ^{ab}	403.95
Calving season ($p < 0.001$; 30.02%) (10)				
Winter (11)	1661	393.08	397.16 ^b	401.28
Spring (12)	1146	404.22	408.81 ^c	413.45
Summer (13)	1800	391.51	395.44 ^{ab}	399.40
Autumn (14)	1771	387.44	391.41 ^a	395.42
Lactation ($p = 0.007$; 6.16%) (15)				
2.	2696	391.13	394.94 ^a	398.78
3.	1764	397.20	401.27 ^b	405.37
4.	969	392.71	397.36 ^{ab}	402.06
5. and more	949	394.48	399.06 ^{ab}	403.70
Sex of the calf ($p = 0.355$; 1.30%) (16)				
Bull (17)	3274	395.33	398.85	402.41
Heifer (18)	3104	393.87	397.45	401.05
Birth weight ($p = 0.002$; 14.72%) (19)			-0.719*	
Error (1.52%) (20)				
Overall mean (21)	6378		398.18	

a, b, c – different letters mean significant ($p < 0.05$) differences (Tukey's post-hoc test) (22)

* – regression coefficient – regressziós együttható

7. táblázat Az ellést megelőző két ellés közötti időtartam (nap)

(1)-től (21)-ig lásd 4. táblázat

a, b, c – a különböző betűk szignifikáns ($p < 0,05$) különbségeket mutatnak (Tukey-féle post hoc teszt) (22)

In the end we can draw the conclusion that the reproductive performance before the actual calving of cows with twins is more favourable and as its consequence supposed to be more economic than that of cows with single birth since twinning cows needed less time to regenerate, their conception rate was better and their length of gestation proven to be shorter. The sum of these factors resulted in a shorter calving interval.

REFERENCES

- Ari M. (2010): Az ikerellések vizsgálata hazai Holstein-fríz tenyészetekben. Diplomamunka. Mosonmagyaróvár.
- Ari M., Vincze B. – Gulyás L. – EBmeyer, C. – Gáspárdy A. (2016): Az évszakok hatásának vizsgálata az ikerellések előfordulására holstein-fríz tehenészetekben. MÁL., 138. 515-522.
- Cady, R.A. – Van Vleck, L.D. (1978): Factors affecting twinning and effects of twinning in Holstein dairy cattle. J. Anim. Sci., 46. 950-956.
- Csukás Z. (1949): Tanulmányok egyiptes szarvasmarha-ikreken. MÁL., 5. 297-301.
- Dell Inc., 2015: STATISTICA (data analysis software system), version 13. www.statsoft.com.
- Djedović, R. – Bogdanović, V. – Stanojević, D. – Nemes, Zs. – Gáspárdy A. – Cseh S. (2016): Reduced vigour of calves born from sexed semen. Acta Vet. Hung., 64. 229-238.
- Fésüs L. (2004): Immuno-, molekuláris és citogenetika állattenyésztési alkalmazása. In: Szabó, F. (ed): Általános állattenyésztés. Mezőgazdasági Kiadó. Budapest, 102.
- Johansson, I. – Lindhé, B. – Pirchner, F. (1974): Causes of variation in the frequency of monozygous and dizygous twinning in various breeds of cattle. Hereditas, 78. 201-234.
- Nielen, M. – Schukken, Y.H. – Scholl, D.T. – Wilbrink, H.J. – Brand, A. (1989): Twinning in dairy cattle: A study of risk factors and effects. Theriogenology, 32. 845-862.
- NÉBIH (2000-2015): Éves zárások
- Olson, K.M. – Cassell, B.G. – McAllister, A.J. – Washburn, S.P. (2009): Dystocia, stillbirth, gestation length, and birth weight in Holstein, Jersey, and reciprocal crosses from a planned experiment. J. Dairy Sci., 92. 6167-6175.
- Silva Del Río, N. – Stewart, S. – Rapnicki, P. – Chang, Y.M. – Fricke, P.M. (2007): An observational analysis of twin births, calf sex ratio, and mortality in Holstein dairy cattle. J. Dairy Sci., 90. 1255-1264.
- Szelényi Z. – Boldizsár Sz. – Bajcsy Á.Cs. – Szenci O. (2009): Ikervemhesség előfordulása és a termelésre gyakorolt hatása hazai tejterelő állományokban. In: Szenci O. – Brydl E. – Jurkovich V. (eds.): A Magyar Buiatrikus Társaság 19. Nemzetközi Kongresszusa, Debrecen, 12-19.

Érkezett: 2016 augusztus

Szerzők címe: Ari M.
Holstein-fríz Tenyésztők Egyesülete
Author's address: National Association of Hungarian Holstein Friesian Breeders
H-1134 Budapest, Lőportár u. 16.
arime@holstein.hu

EBmeyer, C. - Gáspárdy A.
Állattenyésztési, Takarmányozástani és Laborállat-tudományi Tanszék,
Állatorvostudományi Egyetem Budapest,
Department for Animal Breeding, Nutrition and Laboratory Animal Science,
University of Veterinary Medicine Budapest

H-1078 Budapest, István utca 2.
gaspardy.andras@univet.hu

Vincze B.
MTA-ATE Nagyállatklinikai Kutatócsoport
MTA-ATE Large Animal Clinical Research Group
H-2225 Üllő, Dóra major
vincze.boglarka@univet.hu

Gulyás L.
Állattudományi Intézet, Mezőgazdaság- és Élelmiszertudományi Kar, Széchenyi
István Egyetem
Institute of Animal Science, Faculty of Agricultural and Food Science,
Széchenyi István University
H-9200 Mosonmagyaróvár, Vár 4.
gulyas.laszlo@sze.hu