

DOCTORAL (PhD) THESIS

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**TWIN-CALVING AND THE MAJOR REPRODUCTIVE
AND PRODUCTION METRICS IN HOLSTEIN FRIESIAN
DAIRY FARMS**

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2017

1. OBJECTIVES

1. 1. Seasonal effects on twin-calving ratio

The aim of my research was to ascertain the number of twin-calvings, its ratio to all calvings and the seasonal dependencies based on the data of some representative domestic large-scale dairy farms.

1. 2. Reproductive biological metrics of cattle's total lifespan

I analyzed the reproductive biological metrics of single-calving and twinning cows during their whole lifespan, based on a domestic large-scale farm's data.

1.3. Reproductive biological metrics before and after calving

Additional purpose of my analyses was to ascertain single- and twin-calving cows' reproductive biological metrics before and after calving, based on a domestic large-scale farm's data.

1. 4. Comparison of production metrics

The purpose of my analyses was to compare the productions of single- and twin-calving cows and the lactation yields of only twin-calving cows. Moreover, I analyzed the lactation yields of twin-calved cows in comparison to single-calved ones.

1. 5. Twin-calved heifers' first service and first gestation

The purpose of my test is to analyze the differences in the ages of first service of breeding and first gestation between single- and twin-calved heifers.

2. MATERIALS AND METHODS

2. 1. The effect of seasons on twin-calving frequency

For the analysis I have collected 5 dairy farms' data from the years between 2001 and 2010. The distribution of calvings was broken down to seasons (chi²-test).

2. 2. A cattle's lifelong reproductive biological metrics

The collation included all female cattle's and their mothers' data of ancestors, production yields and reproductive biological information that were born between 2000 and 2010. I analyzed the age at first service, first gestation, first calving, and the total lifespan. (Kolmogorov-Smirnov test, GLM – general linear model, Tukey's post hoc method /Statistica ver. 13/ Dell Inc., 2015).

2. 3. Reproductive biological metrics before and after calving

I analyzed the periods between calving to service before calving and after it, the open days before calving, the length of gestation and the calving interval (Kolmogorov-Smirnov test, GLM – general linear model, Tukey's post hoc method /Statistica ver. 13/ Dell Inc., 2015).

2. 4. Comparison of production metrics

The query of 305 days production data was carried out using the RISK application. I compared the milk production of single-calving and twin-calving cows. My analysis included the twin-calving cows' lactation data before and after calving, and their twin progenies' production relative to the single-born herdmates. (linear model, Tukey's post hoc method /Statistica ver. 13/ Dell Inc., 2015).

2. 5. The first service and first gestation of heifers born form twin-calving

I have analyzed the ages of first service and first gestation of twin heifers. (Kolmogorov-Smirnov test /Statistica ver. 13 /Dell Inc., 2015).

3. RESULTS

3. 1. The effect of seasons on twin-calving frequency

The highest frequency of occurrences of twin-calvings was observed to be in the summer months (4.80%). This was followed by the spring season and autumn with 4.05% and 3.83% respectively. After breaking down the results by farms the highest occurrence could be observed on farm A (4.35%), followed by C, E, B, and finally D (3.43%). The seasonal effects on twin-calving frequency can be considered significant ($P=0.002$).

3. 2. Reproductive biological metrics of cattle's total lifespan

The average age of first service on the observed farms was 17.91 months for single and twin-calving cows. There was no significant effect of the observed age on the number of calves born (single or twin), but the breed construction had ($p<0.001$).

On the farms, the first gestation was reached at 18.34 months of age on average. There was no significant effect of the age on the number of calves born (single or twin) either, but the breed construction here also had ($p<0.001$).

On the farms, the average age at first calving was 27.46 months. There was no significant effect of the age on the number of calves born either, but the breed construction had ($p<0.001$).

The average lifespan of a cow was 68.05 months. Significant relation was found between the lifespan and the number of calves born ($p<0.001$), and the breed construction ($p<0.001$), too. Single-calving cows' had 2.23 calves on average, and twin-calving ones had 2.75 ($p<0.001$).

3. 3. Reproductive biological metrics before and after calving

The average length of calving to service period was 74 days. There was no significant effect of the calves' number, breed construction, the number of lactations and the sex of the calves on this time period, although the seasons had ($p=0.002$).

The average time interval between calving to service was 76 days after calving. Significant effects of the number of calves born ($p=0.043$) and the calving season ($p<0.001$) were observed on this period. The breed construction, the number of lactations and the sex of calves had no significant effect.

The average number of open days before calving was 107. It was proven that the number of calves ($p=0.0047$), breed construction ($p>0.001$), calving season ($p>0.001$), and the actual number of lactation ($p<0.012$) had significant effect on the length of this period. Sex found to be no effect on this.

The average number of open days after calving was 116. The number of calves ($p<0.001$), breed construction ($p<0.001$), season of calving ($p<0.001$) and the number of calvings ($p<0.008$) were proven to have significant effects on the results. The sex of the calves had no effect.

The length of gestation before calving was 276 days. The number of calves ($p<0.001$), the season of calving ($p<0.001$) the number of lactation ($p<0.001$) and the sex of the calves born had significant effects. No connection was found between the length of gestation and the breed construction.

The length of gestation after the observed calvings was 279 days on average. The calving season ($p<0.001$) and the number of calvings had statistically proven effect on the length of gestation. The number of lactations (no twin-calving), the breed construction and the sex of the calves didn't affect the length of this period.

The observed farms' average calving interval before calving was 398 days. The number of calves ($p<0.001$), the breed construction ($p<0.001$), the season of calving ($p<0.001$) and the number of lactation ($p<0.007$) had significant effect on this period. The sex of the calves didn't have significant effect.

The farms' cows average calving interval after calving was 404 days. The number of calves ($p<0.001$), the breed construction ($p<0.001$), the season of calving ($p<0.001$) and the number of calvings had significant effects. The sex of the calves didn't have significant effect.

3. 4. Comparison of production metrics

Analyzing the performance of single- and twin-calving cows, no difference was found in the standard 305 days long lactation period's milk, fat and protein production.

Analyzing only those cows that had twins we can draw the conclusion that in all cases the milk production in the first 100 days of lactation has decreased after twin-calving. The production periods' effect before and after twin-calving was statistically significant to all the three production metrics: $p < 0.001$. Using post-hoc tests, I could prove the lower milk yield in the 2. and 3. lactations, and lower fat and protein contents only in the 3. lactation. During the analysis of the standard 305 days long lactation results I could not find significant differences between the productions before and after twin-calving: the 305 days' milk yield's p-value was 0.091, the 305 days' fat quantity's p-value was 0.371, and the 305 days' protein p-value was 0.093. Comparing the standard 305 day milk, fat and protein production of cows born from single-calving to twin-calved ones, I didn't have statistically verified difference ($p = 0.574$) between the two groups.

3. 5. First service and first gestation of twinborn cows

The average age of first service of 3862 single-born heifers was 512 days, and the average age of their 171 twinborn heifer mates was 521 days. No significant difference was found between the two groups' results ($p < 0.10$). Twinborn heifers' successful conception was on day 562. of their lives, while their single-born mates got pregnant successfully on day 546 on average. There is significant difference between the two groups ($p < 0.005$).

4. NEW SCIENTIFIC RESULTS

1. In the insemination period before calving, the length of calving to pregnancy (the days passed from calving to successful conception) was proven shorter for twin-calving mothers (105 days instead of 109 days) ($p < 0.001$).
2. In the insemination period after calving, the length of calving to insemination and calving to pregnancy were significantly more after twin-calvings (78 days instead of 74 and 123 instead of 109 days).
3. Twin-calving cows' calving interval was found to be shorter than that of their single-calving herdmates (392 days versus 404 days) ($p < 0.001$).
4. The total lifespan of twin-calving cows and the number of their calvings were proven to be higher than the single-calving cows' (76 months and 2.75 calvings instead of 61,1 months and 2.23 calvings).
5. The milk, fat and protein yields of twinning cows' first 100 days of lactation before twin-calving was significantly the highest (2934 milk kg, 104 fat kg, 93 protein kg instead of 3121 milk kg, 110 fat kg, 96 protein kg) ($p < 0.001$).
6. No significant difference was found in the ages of first breeding between the single-born and twinborn heifers (512 and 521 days respectively), but twin-calved cows reach the age of first conception later (546 days versus 562 days) ($p < 0.005$).
7. No significant difference was found in milk, fat and protein yields between single- and twinborn cows.

5. LIST OF PUBLICATIONS

List of publications made in the theme of the dissertation

Scientific papers published in peer-reviewed journals (in Hungarian)

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XXXIV. Óvári Tudományos Nap „A magyar mezőgazdaság - lehetőségek, források, új gondolatok”

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Gulyás László - **Ari Melinda** - Orbán Martina (2010): Ikerellések vizsgálata tejelő teheneknél (1.)
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XXXIV. Óvári Tudományos Nap „A Magyar Mezőgazdaság – lehetőségek, Források, Új gondolatok”
(ISBN: 978-963-9883-93-2)

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