RELATIONSHIP BETWEEN MILK PRODUCTION IN DONOR COWS AND THE YIELD AND QUALITY OF EMBRYOS

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Abstract

The relationship between milk production in donor cows and the yield and quality of embryos and oocytes was examined. No significant differences in the yield of embryos among cows with low (group 1), medium (group 2), and high milk production (Group 3) were found. In group 1, there was the higher number of embryos per one donor. A significantly higher percentage of transferable embryos were recorded in the cows in group 1 with low milk production in comparison with group 3 with high milk yield (P<0.01). A slightly negative correlation (r = -0.35) was recorded, i.e. the number of embryos suitable for transfer decreased in cows with higher milk production. Also, a significant higher frequency of occurrence of degenerated embryos was recorded in the donors in group 3 with high milk production (P<0.01) in comparison with the other two groups, while the number of degenerated embryos increased positively in correlation to donors with higher milk production (r = 0.58). No differences emerged in the percentage of yielded oocytes among the groups.

Key words: donor cows, embryos, superovulation, milk yield.

The examination and selection of objective criteria that have an impact on the selection of donors, as well as the variation of superovulation reaction, yield and quality of embryos still remains the subject of study for a number of authors (7, 12). Currently, every possible genetic and breeding endeavour is being made to increase milk production in cows. However, this endeavour is closely related to the decrease in their reproduction capacity (12), primarily in those cows that produce over 6 000 kg of milk per lactation (5, 8). The important reason for embryonic mortality, for instance, is the quality of cow nourishment in a given production period. The amount of energy necessary to support follicular growth, ovulation, and early pregnancy is extremely low in milk-yielding cows with high production in comparison to the demand of energy they need to maintain milk production (3, 18). Any, even a short-term change, as well as an inadequate formula of feed ration in such individuals, mainly during the mating season, has a harmful effect on the developing embryos, even in superovulated cows (3). Some authors have studied ultrastructural differences in oocytes in stimulated and non-stimulated heifers (1). Yaakub et al. (17) compared stimulated heifers fed high and low rations of feed concentrate before slaughtering and, subsequently, they observed in vitro the development and formation of blastocysts from the received oocytes. Several authors also compared the yield and quality of embryos after superovulation in heifers with access to feed concentrates ad libitum and those with restricted ration (6, 9, 15).

Our work focused on the determination of the relationship between milk production in donor cows of the Slovak spotted breed and its crossbreds and the yield, quality, and degeneration of embryos and oocytes.

Material and Methods

The group under study consisted of 52 cows of the Slovak spotted breed and its crossbreds, aged 3 to 6 years, weighing between 490 and 680 kg, from a farm in East Slovakia. The feed ration contained maize and hay silage, fodder beet, with an addition of feed concentrate and hay for further filling-up. All donors had a regular oestrous cycle and no reproduction diseases were detected at the gynaecological examination. They were between days 105 and 210 of lactation. According to their milk production, the donors were divided into three groups. In the first group there were 18 donors with the milk yield lower than 4 500 kg per lactation (5, 8). The important reason for embryonic mortality, for instance, is the quality of cow nourishment in a given production period. The amount of energy necessary to support follicular growth, ovulation, and early pregnancy is extremely low in milk-yielding cows with high production in comparison to the demand of energy they need to maintain milk production (3, 18). Any, even a short-term change, as well as an inadequate formula of feed ration in such individuals, mainly during the mating season, has a harmful effect on the developing embryos, even in superovulated cows (3). Some authors have studied ultrastructural differences in oocytes in stimulated and non-stimulated heifers (1). Yaakub et al. (17) compared stimulated heifers fed high and low rations of feed concentrate before slaughtering and, subsequently, they observed in vitro the development and formation of blastocysts from the received oocytes. Several authors also compared the yield and quality of embryos after superovulation in heifers with access to feed concentrates ad libitum and those with restricted ration (6, 9, 15).

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the Czech Republic) that was administered in a decreasing dose during 4 d in 12-h intervals; 80 M.U. on day 1, and 40 M.U. on days 3 and 4. On day 3 from the beginning of the superovulation treatment, prostaglandin \( \mathrm{F_2} \alpha \) (Cloprostenol.Oestrophan inj. a.u.v., Léčiva, the Czech Republic) was administered in a dose of 250 µg, twice at a 12-h interval. The donors were inseminated 3 times with a double dose of sperm within the period of 2 days. The flushing was applied to yield embryos on days 7 and 8 after the insemination by a non-surgical method. The quality of superovulation reaction was examined by manual palpation and ultrasonography in terms of the number of \( \mathrm{corpora lutea} \) on the ovaries. The observation and evaluation of the quality of embryos (obtained, transferable, degenerated, and oocytes) was performed in Petri dishes by stereomicroscopy under 50x magnification according to Pivko and Grafenau (10). The results were processed statistically by a computerized chi-test, where means and standard deviations were calculated. Statistic significance of differences was assessed by the t-test. The relationship between the milk production and yield and quality of embryos was expressed by means of a correlation analysis and a correlation coefficient \( r \).

**Results**

In the first group, the total of 116 embryos and oocytes were flushed, which amounted to 6.5±1.9 per one donor, in the second group 124 embryos and oocytes were obtained, which was 5.4±2.8 per one donor, and in the third group there were 51 embryos and oocytes, with 4.7±2.2 per one donor. The differences among groups with respect to the number of obtained embryos and oocytes per one donor were not statistically significant (\( P<0.05 \)); nevertheless, the recorded not significant negative tendency showed a slight decrease in the yield of embryos in cows with higher milk production (Table 1). The percentage of suitable transferable embryos was higher in the cows with the milk production lower than 4 500 kg, namely 58.7%, in comparison to the cows with the milk production between 4 500 and 6 500 kg (48.4%) and with the cows with the milk production greater than 6 500 kg (40.1%). The differences between groups 1 and 3 were statistically significant (\( P<0.01 \)), and among all the observed groups a slight negative correlation was discovered (\( r = -0.35 \)), thus, the number of suitable embryos decreased with the increasing milk production. Most significant differences were seen in the observation of degenerated embryos, where the higher number of those was recorded among the donors in group 3 i.e. in 37.35% in the flush in comparison to group 2 with 29.40% and group 1 with 17.52%. The results were statistically significant (\( P<0.01 \)) and the positive correlation analysis was carried out (\( r = 0.58 \)); thus, the increasing milk yield led to the increase in the number of degenerated embryos unsuitable for further application. The percentage of oocytes in all groups did not show any statistically significant differences (Table 1).

**Discussion**

The relationship between milk efficiency and the yield and quality of oocytes was studied by Snijders et al. (13) who obtained oocytes from cows with a high and medium genetic predisposition towards milk production. Insufficient development of oocytes \textit{in vitro} into the blastocyst stage was observed, as well as many degenerative changes in blastocysts in the milk-yielding cows with high milk production in comparison to those with low milk production. Also, the higher number of bad quality oocytes and degenerated embryos was recorded in cows with high milk production and weak physical condition (16). Several authors (2, 4, 11, 14) pointed to the possible harmful effect of high-energy nourishment in the milk-yielding cows with high production on the quality of embryos both in superovulated and in non-superovulated cows and sheep.

<table>
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<tr>
<th>Table 1</th>
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<tr>
<td><strong>Yield and quality of embryos obtained from donors with different milk production</strong></td>
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<table>
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<tr>
<th>Group</th>
<th>Number of donor cows</th>
<th>Yield of milk (kg/year)</th>
<th>Number of embryos per donor cow</th>
<th>Total number of yielded embryos and oocytes</th>
<th>Number and percentage of transferable embryos</th>
<th>Number and percentage of degenerated embryos</th>
<th>Number and percentage of non-fertilized ova</th>
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<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>&lt;4500</td>
<td>6.5±1.9 a1</td>
<td>116</td>
<td>68 (58.7) b1</td>
<td>20 (17.52) c1</td>
<td>28 (23.78) d1</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>4500-6500</td>
<td>5.4±2.8 a2</td>
<td>124</td>
<td>60 (48.4) b2</td>
<td>36 (29.4) c2</td>
<td>28 (22.2) d2</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>&gt;6500</td>
<td>4.7±2.2 a2</td>
<td>51</td>
<td>20 (40.1) b2</td>
<td>19 (37.35) c2</td>
<td>12 (22.55) d2</td>
</tr>
</tbody>
</table>

\( \pm SD \)

\( a- a_1=P>0.05; a- a_2=P>0.05; a_1- a_2=P>0.05; b- b_1=P>0.05; b- b_2=P<0.01; b_1- b_2=P>0.05; b- b_1- b_2=r=-0.35; \\
\( c- c_1=P<0.05; c_1- c_2=P<0.05; c- c_2=P<0.01; c- c_1-c_2=r=0.58; d- d_1- d_2=P>0.05. \)
Mantovani et al. (6) presented a significantly lower yield and quality of embryos in heifers that were fed *ad libitum* in comparison with those with restricted feed rations. The concentration and quality of feed ration influenced the yield and number of transferable embryos, even after cow superovulation (15). In our study, an insignificantly higher yield of embryos in the cows with lower milk production was recorded. In the cows with high milk production, a significantly lower quality and number of transferable embryos was observed, as well as the higher number of degenerated embryos in comparison with the donors with medium and lower milk production.

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**References**