The Influence of Milk Production on Reproductive Indices in Cows Inseminated with HeiferPlus Semen

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Abstract
More and more dairy cows with high milk producing are experiencing infertility problems caused by both negative postpartum energy balance and the inhibitory action of the hormone prolactin on the hormones GN-RH and FSH. The present paper analyses the relationships between milk production and reproductive indicators in a population of dairy cows that were artificially inseminated with HeiferPlus semen. This semen, according to those who sell it, increases the percentage of fecundity by 5-15% and the sex ratio is 65-85% in favour of the calf with the predetermined desired sex. The work was carried out at the Balotesti Bovine Development Research Institute, on a herd of 50 heads, Romanian Black Spotted cows, owned by the institute. The analysed data capture the farm's activity between years 2020 -2021. Milk production was monitored by the specialists who carry out the Official Control of Milk Production and the reproduction data were taken from the TAURINE.EXE farm program. The reproductive indicators monitored were: conception rate, services per conception, non-return rate, service period interval and sex ratio. The statistical processing of the data was carried out using the Microsoft Excel program.

Keywords: milk production, reproduction indicators, semen HeiferPlus.

1. Introduction

Increasing the efficiency of dairy cows is achieved by increasing their production and reproduction performance. In most cases, cows with high milk production have infertility problems that can be caused by the negative energy balance [1,2] that sets in after parturition or by the inhibition of the GN-RH hormone by the Prolactin hormone. This leads to the worsening of the reproductive indicators with consequences on the productive performances of the cows. Or in the context where the economic factor is decisive in the reformation of cows, and the selective reformation is carried out on the basis of production and reproduction indicators, it is possible that a good animal, with high productive potential, will be sent to the slaughterhouse before reaching its maximum potential according to Equivalent Maturity indicator [3].

2. Materials and methods

This paper analyses reproductive indicators in relation to milk production/lactation in a batch of cows artificially inseminated with HeiferPlus semen. This sperm, according to those who sell it, increases the fecundity percentage by 5-15% compared to conventional semen, and the sex ratio is 65-85% in favour of calves of the desired predetermined sex. The work was carried out at the Balotesti Bovine Development Research Institute, on a herd of 50 heads, Romanian Black Spotted cows, owned by the institute. The analysed data capture the activity on the farm between the years 2020-2021. Milk production was monitored by the specialists who carry out the Official Control of Milk Production

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and the reproduction data were taken from the TAURINE.EXE farm program. The reproductive indicators monitored were: %fecundity, services per conception, non-return rate, service period interval and sex ratio. The statistical processing of the data was carried out using the Microsoft Excel.

3. Results and discussion

Table 1 shows the milk production of cows by productivity group.

Table 1. The average milk production/lactation of the cows in the analysed batch

Statistical indicators	Milk production 5000-6000 (kg)	Milk production 6001-7000 (kg)	Milk production <7000 kg
n	15	18	17
$\bar{X}$	5558.267	6562.33	7624.4
SD	308.84	348.705	479.58
CV%	5.55	5.31	6.29
MIN	5024	6026	7054
MAX	5974	6994	8621
Differences in milk production 5000-6000 kg ~ 6001-7000kg			p=0.84363; p>0.05
Differences in milk production 5000-6000 kg ~ milk production greater than 7000 kg			p=0.165438; p>0.05

Table 1 shows that cows were divided into three productivity groups based on their own performance recorded during a lactation. Thus, in the first group, consisting of 15 cows, the cows that had a milk production between 5000 kg and 6000 kg were assigned. The average milk production/lactation recorded for these cows was approximately 5558 kg milk. The variance within this group was 308.84 kg and the variability was 5.55%. This reduced variability shows the homogeneity of the batch. The lowest milk production recorded in this group was 5024 kg of milk and the highest was 5974 kg. The second group consisted of cows that had a milk yield between 6001 kg and 7000 kg. This group had 18 heads in its composition, being also the most numerous. The average milk production recorded in this batch was 6562.33 kg of milk/lactation with a small variability of 5.31%. the dispersion within the group was 348.70 kg of milk. The lowest milk production recorded in this group was 6026 kg and the highest was 6994 kg of milk/lactation. The productivity difference between the minimum production and the maximum production within this group was 16.06%. In the third group were registered the cows with productions greater than 7000 kg of milk/lactation. This group consisted of 17 heads and the average milk production recorded was 7624.4 kg of milk/lactation. The variability within this group was 6.29% and the dispersion was 479.58 kg of milk. The lowest milk production recorded within this group was 7054 kg and the highest 8621 kg/milking. The productivity difference between the minimum production and the maximum production within this group was 22.21%. The Fisher test analysis shows that there are no significant differences between the groups of cows with productions of 5000-6000 liters/lactation and those with productions between 6001 and 7000 litters/lactation (p=0.84363; p>0.05). Insignificant differences were also recorded between the groups of cows with productions of 5000-6000 kg of milk and those with productions of over 7000 kg of milk/milk (p=0.165438; p>0.05)

Table 2 shows the reproductive performances of the group of cows with productions between 5000 - 6000 kg of milk/lactation.

Table 2. Reproductive performance in cows with production between 5000kg - 6000kg of milk/lactation

Statistical indicators	Milk production	% Non-return	Services per conception	%fecundity	Service period	Sex ratio
X	5558.267	76%	1.66	72.96	81.93	56.5
Correl milk production~number services per conception (SPC)						-0.20752
Correl milk production~service period						-0.18035
Chi test analysis %non-return %fecundity obtained~% non-return %fecundity desired						p=0.186486; p>0.05
Chi test analysis of the ratio obtained with HeiferPlus semen~the sex ratio obtained with conventional semen						p=0.193601; p>0.05

Table 2 shows that the percentage of no-returns in cows artificially inseminated with HeiferPlus semen was 76%. The fecundity rate recorded in this group was 72%, which equates to good fecundity [4]. The time from calving to fertile insemination was about 82 days, which shows that this lot can be said to have fulfilled the desire to have a yearling and a calf. The number of services per conception (SPC) performed to achieve a pregnancy was 1.66[5] which equates to a good score. The percentage of females obtained after insemination with HeiferPlus semen was 56.5%, which shows an increase of + 6.5% compared to the ratio of 50% normally obtained by using conventional semen. Analysis of the correlation between milk production and the number of services per conception performed to achieve a pregnancy shows that there was a negative correlation between them. This fact shows that a higher milk production can be obtained by decreasing the number of inseminations performed. The analysis of the correlation between milk production and service period (SP) shows that there is a negative correlation between these indicators, which shows that a higher milk production can be obtained by reducing the service period. The analysis of the CHITEST indicator shows that there are no significant differences between the percentage of fecundity obtained and the percentage of fecundity sought to be obtained ($p=0.432485$; $p>0.05$). The analysis of the CHITEST indicator shows that there are no significant differences between the obtained and the normal sex ratio of 50-50 ($p=0.193601$; $p>0.05$). From the data analysis, it is found that with an average production of 5558.26 kg of milk/lactation, the monitored reproduction indicators are within normal limits, a fact that favours the economic growth of the farm.

Table 3 shows the reproductive performances of the group of cows with productions between 6001 - 7000 kg of milk/lactation.

Table 3. Reproductive performance in cows with productions between 6001 - 7000 kg of milk/lactation

Statistical indicators	Milk production	% Non-return	Services per conception	%fecundity	Service period	Sex ratio
X	6574.278	71%	1.83	65.35	90.66	57.5
Correl milk production~number services per conception (SPC)						-0.19334
Correl milk production~service period						-0.17285
Chi test analysis %non-return %fecundity obtained~% non-return %fecundity desired						p=0.012617; p>0.01
Chi test analysis of the ratio obtained with HeiferPlus semen~the sex ratio obtained with conventional semen						p=0.13614; p>0.05

From Table 3 it can be seen that with an average milk production/cow of 6574 kg. The registered fecundity percentage was 65.35% and the non-return percentage was 71%. Even if the result obtained shows a percentage decrease in pregnancies compared to the previous batch, it can be considered that the percentage of fecundity obtained in this group is within acceptable limits. To obtain a pregnancy, 1.83 services were performed per conception, which equates to a good fecundity. The elapsed time from farrowing to fecund insemination was approximately 91 days, which represents an acceptable time interval [6]. The percentage of females obtained was 57.5%, which represents an increase of 7.5% compared to the percentage normally obtained by using conventional semen. From the analysis of the ratios between milk production and the number of artificial inseminations/gestations, it is found that there is a negative correlation between the two indicators. This shows that milk production can increase by reducing the number of services per conception. The analysis of the relations between milk production and the duration of the service period shows that there is a negative correlation between the two indicators. This type of correlation shows that shortening the service period will naturally lead to an increase in milk production by improving the calving interval indicators and milk production/day fed. The CHITEST analysis shows that there are no significant differences ($p= 0.133614$; $p>0.05$) between the gender ratio obtained of 57.5% females and the normal ratio of 50% females. From the CHITEST analysis, it is found that there

are significant differences (p=0.012617; p>0.01) between the desired fecundity percentage and the registered one. Even if this test shows that there are differences between the achieved and the desired fecundity, the recorded result shows that at this score a farm can be sustainable. The data analysis shows that at an average production of 6574,278 kg of milk/lactation, the monitored reproduction indicators are within acceptable limits and do not affect the farm management and this is in favor of the farmer.

Table 4 shows the reproductive performances of the group of cows with productions greater than 7000 kg of milk/lactation.

Table 4. Reproductive performance in cows with productions greater than 7000 kg/lactation

Statistical indicators	Milk production	% Non-return	Services per conception	%fecundity	Service period	Sex ratio
X	7623.706	67%	1.88	62.31%	96.64	58.5
Correl milk production~number services per conception (SPC)						-0,43804
Correl milk production~service period						-0.16951
Chi test analysis %non-return %fecundity obtained~% non-return %fecundity desired						p=0.001514; p<0.01
Chi test analysis of the ratio obtained with HeiferPlus semen~the sex ratio obtained with conventional semen						p=0.089131; p>0.05

Table 4 shows that with an average production of 7623 kg of milk/lactation, a fecundity percentage of 62.31% was recorded. To obtain this percentage of pregnancies, 1.88 services were performed per conception. The duration of the service period for this group of cows was 96 days [7], which represents an acceptable limit for cows with high productions. The ratio of females obtained was 58.5%, 8.5% higher than the conventional ratio of 50% [8]. From the analysis of the relationships between milk production and the number of artificial inseminations/gestations, it is found that there is a negative correlation between the two indicators, which shows that milk production can increase by reducing the number of services per conception. The analysis of the relationship between milk production and the duration of the service period shows that there is a negative correlation between the two indicators, which means that an increase in milk production is possible by decreasing the duration of the service period. From the analysis of the significance test of the CHITEST differences, it shows that there are distinctly significant differences (p=0.001514; p≥0.01) between the desired fecundity percentage and the registered one. Even if from the point of view of meaning the differences between the two indicators are very large, from the practical point of view these differences are acceptable. From the CHITEST analysis, it is found that in this batch there are no significant differences (p= 0.089131; p>0.05) between the percentage of females obtained by using HeiferPlus semen, of 58.5%, and the ratio of 1/1 that is naturally recorded by the use of conventional semen. From the analysed data, it is found that with an average production of 7,623,706 kg of milk/lactation, the monitored reproduction indicators are kept within normal limits. Even if the increase in milk production affects the reproductive activity to some extent, the production performance recorded compensates for these losses and increases the farmer's income.

Table 5 shows the reproductive performances according to the productivity of the analysed cows.

Table 5 shows that the highest non-return rate, 76%, was recorded in the group of cows with productions between 5000 and 6000 kg of milk/lactation and the lowest of 67% in the group of cows with productions of more than 7000 kg. milk/lactation. The percentage difference between these two groups was 13.43%. The highest percentage of fecundity, of 73%, was in the group of cows with milk production between 5000-6000 kg/lactation. This was 11.64% higher than the percentage of pregnancies obtained in the group of cows with productions between 6001 and 7000 kg of milk. The fewest pregnancies were recorded in the group of cows with productions of over 7000 kg of milk/lactation. Of these, 17.09% pregnancies were obtained compared to the leading group. From the data presented, it is found that milk production influences the fecundity of cows. Furthermore, there is a negative correlation between these two indicators showing that as milk production increases, fecundity decreases.

Table 5. Comparative analysis of the reproductive indicators monitored according to milk production

Reproduction indicators	Milk production/lactation (kg)			The percentage difference in reproductive performances between groups	
	Milk production 5000 – 6000 kg	Milk production 6001- 7000 kg	Milk production >7000 kg	5000-6000kg ~ 6001-7000 kg	5000-6000kg ~ >7000 kg
% NON-RETURN	76%	71%	67%	+2.81%	+13.43
SPC	1,68	1,83	1,88	-8.92	-11.90
%FECUNDITY	72,96%	65,35%	62,31%	+11.64%	+17.09
SP	81,93	90,66	96,64	-10.65	-17.95
SEX RATIO	56,5	57,5	58,5	-1.76	-3.53
Analysis of SPC differences in milk production 5000-6000 kg ~ SPC 6001-7000 kg				p=0,605355; p>0.05	
Analysis of SPC differences in milk production 5000-6000 kg ~ SPC >7000 kg of milk				p=0,95779; p>0.05	
Analysis of SP differences in milk production 5000-6000 kg ~ SP 6001-7000 kg				p=0,447488; p>0.05	
Analysis of SPC differences in milk production 5000-6000 kg ~ SPC >7000 kg of milk				p=0,064001; p>0.05	

The fewest services per conception, 1.68, were performed in the group of cows with low milk production. In this batch, 8.92% less semen was used compared to the batch with medium productions and 11.90% less compared to the batch with high milk productions. From the analysed data, it can be seen that there is a positive correlation between milk production and the number of inseminations performed to obtain a pregnancy. This shows that with the increase in the productivity of the cows, the number of inseminations/gestations also increases.

Cows with yields between 5000 and 6000 kg of milk had the shortest period of open days. The duration of the service period in this group was 82 days, 10.65% less than in medium-producing cows and 17.95% shorter than in high-producing cows. From this analysis it is found that with the increase in milk production, the number of service period days also increases. This can be caused by the inhibition of FSH by the hormone Prolactin, which favours the occurrence of postpartum anaesthesia. Another favourable factor may be the negative energy balance recorded in the first part of lactation, which favours the delay in the resumption of the ovarian cycle.

The highest percentage of females obtained was 58.5%. This was recorded in the group of cows with high productions. From these, 1.76% more females were obtained than in the group of cows with medium productions and 3.53% more females compared to the group with low productions.

The analysis of the significance of the differences shows that there are no significant differences between cows with small productions and those with medium productions in terms of the number of services per conception performed to obtain a pregnancy ($p=0.605355$; $p>0.05$). Insignificant differences were also recorded between cows with low productions and those with high productions regarding the number of services per conception ($p=0.95779$; $p>0.05$). The Fisher test was also used to analyse the duration of the service period. It showed that insignificant differences were registered between cows with small productions and those with medium productions ($p=0.447488$; $p>0.05$). Insignificant differences were also recorded between the groups of cows with low productions and those with high productions $p=0.064001$; $p>0.05$).

4. Conclusions

High milk production influenced the fecundity percentage in cows inseminated with HeiferPlus semen.

High milk production influenced the duration of the service period in cows inseminated with HeiferPlus semen.

The best reproductive performances were recorded in cows with productions between 5000 - 6000 kg/lactation.

Cows with productions over 7000 kg negatively influence the reproductive activity but do not affect the sustainability of the farm.

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