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THE INFLUENCE OF GROWTH RATE ON PRODUCTIVE CHARACTERISTICS AT DAIRY HEIFERS FED WITH MATERNAL WHOLE MILK AND MILK REPLACER

VESNA K. HRISTOVA[1], M. AYAZ AHMAD[2], KITANOVSKI DIMCE[1], LJUPCE KOCOSKI[1] AND BILJANA TRAJKOVSKA[1]

[1]University of St. Kliment Ohridski, Faculty of Biotechnical Sciences,
Partizanska b.b., Bitola, Macedonia
[2]Physics Department, Faculty of Science, P.O. Box 741,
University of Tabuk, 71491, Saudi Arabia

Abstract

Producing high quality heifers that will express their genetic potential for milk production and allow optimal duration in the milking herd (longevity) is a priority objective to balance the investment of 15-20% of total costs of milk production with a net return to the dairy. The primary accent of this research work is to study the nutrition of female calves with whole milk in the first 90 days after the birth, and could be applied in the rearing methods in the management of the herd of replacement heifers. For this aim we were used fourteen female calves of Holstein-Friesian breed and divided it into two groups named as; experimental group A-7 and control group B-7 (calves fed on colostral milk during the first seven days, and later fed according the standard routines). T-test we have calculated by statistical analysis and its values were showing important diferences between the parameters of two groups of heifers (group A and group B) on a level of $p < 0.05$ and $p < 0.01$. The results referring to the weight of heifers (group A) when calving and lactation showed high dependence, high degree of correlation ($r = 0.79$) by the interrelation of body mass during the sixth measurement and average daily milk yield in the first month of lactation – of group A. Finally, we have reached a degree of correlation of ($r = 0.85$) which confirms that calving weight and the increased growth rate have a positive influence over the milk yield in the period of first lactation which already confirms the established results on a global level.

Keywords: Holstein-Friesian breed of cattle, growthrate, milk production in the first lactation.

1. INTRODUCTION

One of the greatest problems of today, humanity is struggling with, is the issue of feeding people, especially the problem of producing sufficient quantities of food of animal origin. This problem is larger every day because various reasons permanently reduce the space where food is produced, also the number of inhabitants increases vertiginously (about 200,000 people daily), which leads to a tragic situation where a third of the humanity is chronically starving and dying of hunger every day, and another third of the world's population is rarely fed.

In most countries, cattlebreeding takes 45-60% (milk, meat) of the total value of agricultural production, so it would be totally justified to say that it is actually an animal products industry. Economic success in stockbreeding production depends on several factors, including genetic (specificity of the race) and non - genetic factors (nutrition, care, health, etc).

With the liberalization of imports of cattle from the EU in R. Macedonia, in many occasions (1948-1955, 1963-1968, 1974-1976 and the last mass import 2004-2006), a large number of cows with high genetic potential is purchased, as is Holstein-Frisian dairy breed, which is economically most profitable dairy breed and belongs to a group of black and white plain cattle. Among the numerous positive characteristics such as low feed cost per kg of milk produced, offering the highest income per kg milk, their good reproductive traits, easy calving and giving vital calves, early maturation and good growth and growth rate, there is the genetic potential for milk production, compared to other races as one of the key features.

The impact of non genetic factors, different types of feeding the offspring, the females selected for breeding cattle, directly depend on the changing conditions of the market price of the normal raw milk compared to the regenerated milk.

The replacement heifers, its growth rate is representing one of the main indicators of the management itself. Monitoring their growth is being done for several reasons such as: avoiding and postponing their reproductive age and their first calving as a result of its slow growth, feeding management rate, getting adequate body mass while it’s first calving and getting the problems down to its minimum level during the first calving (Michel A.Watiaux, 2004). Raising high quality heifers that will express their genetic potential for milk production and allow optimal duration in the milking herd (longevity) is a priority objective

to balance the investment of 15-20% of total costs of milk production with a net return to the dairy (Lormore M., 2005). Hutjens (2004), concluded that replacement heifers (and calves) provide the basis for profitable milking herds as a source of genetically superior cows, allow for the culling of marginal cows, expand the dairy operation and/or provide a source of added revenue by selling surplus animals. According to Milojevic (1984) the growth is being examined and determined measuring the body mass and its exterior, determining its growth rate etc. Growth rate, in fact, represents any positive difference in body mass, whereas from the biological point of view, increase in fats does not correlate with the growth, unless it happens in parallel with the formation of muscle and other tissues.

The need to prove the impact of the female calves growth rate on their productive characteristics was being initiated with main purpose all of the received data to give important theoretical and practical contribution to the development of the Animal husbandry in our country, with an immense contribution to the production of qualitative reproductive offspring and proper replacement heifer management.

In the present paper, we have studied some valuable parameters by statistical method such: body mass measuring and milk yield (305 days lactation) of cows calved for the first time. And by data processing, some of arithmetic values of certain parameters as the degree of latitude, degree of freedom (D.F.), Hi-square and coefficient of correlation (r), have been calculated and reported and also our results found satisfactory with other workers [1-7].

2. MATERIAL AND METHOD USED

In our present work the experiment is being performed in one Dairy Farm in the Pelagonian Region in R. of Macedonia. As an experimental material 14 female calves of the Holstein Friesian breed has been taken and divided in 2 groups of female calves (**A** – experimental group, consisting of 7 calves and another one **B** – control group, also consisting of 7 calves). These two consolidated groups of calves were fed differently from birth until the age of 90 days (group **"A"** fed with natural whole maternal milk, and group **"B"** fed with a milk replacement – Kalvolac). From the moment of calving until the 7^{th} day of age the newly born calves were fed through nipples with colostrum milk from their mothers, which are obtained by machine milking. Then, they were divided in separate boxes in the prophylactic department for calves. From day 7 up to day 90, the calves from group **A** were fed, especially with natural whole milk, while the calves from group **B** were fed with milk

replacement. Milk replacer was reconstituted once or twice daily in special milk mixers and was normally mixed to achieve a final temperature of 42°C as an important temperature to achieve optimum digestibility. From 60-150 days of age, the calves from both groups **A** and **B** were fed with STARTER 2 (min 15% proteins and max 8% crude fiber) 3- 4 kg per calf / 24 hours + alfalfa hay.

The composition of STARTER 2 for calves was (wheat 10%, soy grits 11%, corn 60%, barley 10%, soy 5%, sunflower oilcake 4%, vitamins A, D, E, antioxidants Cu, J, and minerals Se, Co, Mn, Mg, Fe, Zn). The further feeding the heifers and first-calving cows has been described in Table 1, according to the rationing program of the dairy farm.

As for the diet of dairy cows on the dairy farm feed was given throughout the year as a total mixed ration, and the cows were never turned out to graze. Diets feed before and after calving was formulated to exceed National Research Council (NRC, 2001), recommendations and the residues of the dietary feed were generally observed in the herd.

During the control period, with the help of livestock scale the birth weight of the female calves was measured. That value, further served as a starting point for determining the growth rate. Measurements of the body weight were done monthly (6 measurements totally) until the animal is sent to reproduction center. Besides the body weight, the next measurements at the calves were done by the followings:

- Measuring the body weight at first breeding of the heifers,
- Measuring the body weight after parity (on the day of calving),
- Monthly control of the milk yield in the first lactation.

The absolute growth rate (P_{ab}) is increase of the live body mass for a certain period and represents the difference between the final and the initial value for a certain number of days or months. The absolute growth rate (P_{ab}) and average daily growth (P_D) can be calculated by the following arithmetic relations:

$$P_{ab} = V_f - V_i$$

$$P_D = \frac{V_f - V_i}{t}$$

Where V_f and V_i are the final and initial values and $t = t_2 - t_1$ is the time difference between two consecutive measurements and expressed in days.

Table 1: Standardized nutrition and the daily meal of the examined calves from groups A and B (from the age of 0-27 months).

Group A (nutrition with whole milk)		**Group B (nutrition with milk replacement – Kalvolac)**	
Time Period	Characteristics	Time Period	Characteristics
From 0 - 7 days	Colostrum milk	From 0- 7 days	Colostrum milk
From 8 - 9 days	2 x 2.5 L, whole maternal milk	From 8 - 9 days	2 x 1.5 L, whole maternal milk + 1.5 L, milk replacement
From 10-90 days	2 x 3 L, whole maternal milk	From 10-90 days	2 x 3 L, milk replacement
From 60-150 days	Starter 2 (min 15% proteins and max 8% crude fiber), 3-4 kg per calf /24 hours + alfalfa hay IV – mowing	From 60-150 days	Starter 2 (min 15% proteins and max 8% crude fiber), 3-4 kg /24 hours + alfalfa hay IV – mowing
From 5-20 months	Silage hay - 4 *kg*,	From 5-20 months	Silage hay- 4 *kg*,
	Silage - 8 *kg*,		Silage - 8 *kg*,
	Alfalfa hay - 2.5 *kg*,		Alfalfa hay - 2.5*kg*,
	Straw - 0.5 *kg*,		Straw - 0.5 *kg*
	Concentrate -2 *kg*		Concentrate - 2 *kg*
From 20-24 months	Silage hay -4 *kg*,	From 20-24 months	Silage hay -4 *kg*,
	Corn -2.5 *kg*,		Corn - 2.5*kg*,
	Dry sugar beet pulp -1 *kg*,		Dry sugar beet pulp -1 *kg*,

Group A (nutrition with whole milk)		**Group B (nutrition with milk replacement – Kalvolac)**	
	Super concentrate -2 *kg*,		Super concentrate -2 *kg*,
	Silage -10 *kg*,		Silage - 10 kg
	Alfalfa hay- 3 *kg*,		Alfalfa hay -3 *kg*,
	Straw -1.5- 2 *kg*		Straw - 1.5- 2 *kg*
From 24-27 months	Silage hay -7 *kg*,	From 24-27 months	Silage hay -7 *kg*,
Phase one until 100 days (milking period)	Corn -6 *kg*,	Phase one until 100 days (milking period)	Corn -6 *kg*,
	Sugar beet pulp -1.5 *kg*,		Sugar beet pulp -1.5 *kg*,
	Super concentrate -11*kg*,		Super concentrate - 11*kg*,
	Silage -18 *kg*,		Silage -18 *kg*,
	Alfalfa hay - 4 *kg*,		Alfalfa hay - 4 *kg*,

3. RESULTS AND DISCUSSION

We were measureing the body masses of each calf with an observation time (in days) by a livestock scale with the help of FARM workers. To determine the correlation between certain parameters, applicative software was used. We have studied the degree of latitude D.F., Hi-square and coefficient of correlation (r). All correlations with contingency coefficient greater than 0.6 (the highest value of r = 1) were taken into consideration.

An average (arithmetic) value of certain parameters is calculated, and by using T - test and ANOVA test the statistical significance of the differences of some parameters between two groups of cows. We found that the statistical value of the importance of different parameters of two groups of heifers (group **A** and group **B**) on a level of p-values $p < 0.05$ and $p < 0.01$.

The arithmetical mean of the body mass values and absolute growth rates (group **A** and group **B**) has been shown in Table 2.

Table 2: Arithmetical mean values of the body mass value and absolute growth rate (group A and group B).

Aritmetical mean values	**Group A female calves body mass (*kg*)**	**Growth rate of female calves of group A (*kg*)**	**Group B female calves body mass (*kg*)**	**Growth rate of female calves of group B (*kg*)**
Birth weight	33.43	---	33.43	---
Ist measurment (age of calves -1month)	38.43^{a}	5.00	39.00^{b}	5.57
II nd measurment (age of calves - 1.5 month)	48.29^{c}	9.86	44.00^{d}	5
IIIrd measurment (age of calves - 2.5 months)	67.57^{e}	19.28	60.29^{f}	16.29
IVth measurment (age of calves - 3.5 months)	83.29^{g}	15.72	69.71^{l}	9.42
Vth measurment (age of calves - 4.5 months)	96.43^{m}	13.14	84.29^{n}	14.58
VIth measurment (age of calves – 6.0 months)	150.00^{p}	53.57	127.86^{q}	43.57

From Table 2, one can see that the differences between the values of measured steps Ist to VIth) and different superscripts values (T-test values) are statistically significant at a ***p-level***

($p < 0.01$) for all set of superscripts a with b, c with d, e with f, g with l, m with n and p with q.

Therefore, finally from Table 2, it can be concluded that birth weight rate, the body mass and the growth rate of the female calves of group A and group B, there is a significant difference of the weight. It implies that in conditions of equal birth weight and age, and later on following the measurements of their body mass, the significant difference occurs during their sixth measurement for 22.14 kg in addition of the female calves of group A. All of this occurs as a result of the influence of the nutrition with whole maternal milk till their 90th day of age, because even though that all of the female calves from the both different groups were being raised under the same conditions, and they were being placed in two identical boxes, the only difference that was being performed during this experiment was their different nutrition (full fat whole milk for group A and milk replacer for group B). The differences in the average body mass presented in kilos during their six sub sequential measurements among the two groups A and B have a significant p level ($p < 0.01$)

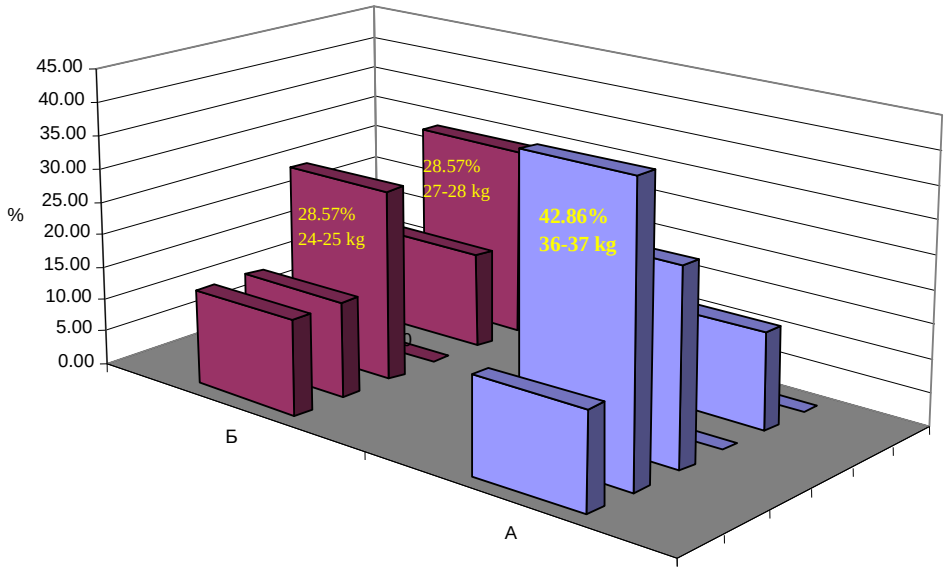

Figure 1 : First - calving cows milk production in the first month of lactacion (group A and B).

The milk production has been shown in Figure 1. From this figure, it can be concluded that First - calving cows of group-A have an average milk production in their first month of lactation 36-37kilos per day, (42.86% of them, give 36 to 37 kilos of milk per day) , whereas the First - calving cows from control group-B, around 28.57% of the cows give 24-25 and 27-28 kilos of milk during the first month of lactation. The conclusion is that the difference of milk production between these two groups is 10-13 kilos of milk daily, in addition of the group- A.

The author Pollard B. C. (2007) as in our research demonstrate a possitive answer regarding early age feeding programs of one side and milk production on the other side. The statistical values for various correlations have been shown in Table 3 and Table 4.

Table 3: The correlation between the parameters of the birth-weight and milk production in the first month of lactation (n1 and n11 of group A) and (n14 and n24 of group B).

Parameters	**D. F.**	**Hi**	**r**
	n11 (A)		
n1 (A)	4	4.28	0.62
	n24 (B)		
n14 (B)	10	11.38	0.79

n1 – female calves birth-weight – group A

n11 – milk production in the first month of lactation – cows group A

n14 - female calves birth-weight – group B

n24 - milk production in the first month of lactation – cows group B

From the cross parameters as mentioned in Table 3, one can say that the female calves birth weight and milk production in the first month of lactation for the group A (n1 & n11), the coefficient of contingency or correlation is found r = 0.62. Results of this we can be concluded that these two values correlate very well.

By mathematical calculation of correlations between, female calves birth weight and milk production in the first month of lactation – group **A** (n14 & n24), were obtained and the coefficient of correlation r = 0.79 where it can be concluded that in these two crossings exists a very strong correlation.

Table 4: The correlation between the parameters body weight at VIth measurement and average daily milk production in the first month of lactation (n7 and n11 of group A) and (n 20 and n 24 of group B).

Parameters	D. F.	Hi	r
	n11(A)		
n7 (A)	20	18.08	0.85
	n24(B)		
n20 (B)	35	24.50	0.88

n7 – body weight at VIth measurement – group A

n11 – average daily milk production in the first month of lactation – group A

n20 - body weight of VIth measurement – group B

n24 - average daily milk production in the first month of lactation – group B

Finally, according to the invoice between the body mass during the VIth measurement and the average daily milk production in the first month of lactation (n7 and n17) in group A, out of the two crossings, we got coefficient of correlation r = 0.85 which represent a very strong level of correlation . By statistical calculation of correlations of the parameters body mass during the VIth measurement and the average daily milk production in the first month of lactation in control group B (n20 and n24), we got coefficient of correlation r = 0.88 with which we can conclude that between these two crossings there is a strong correlation. The growth rate and weight gain in the first lactation are considered the most important parameters in the management of milking cows (Sejrsen and Purup, 1997) [5]. Hence our results are in good satisfactory with the other workers in the field of Veterinary Sciences [1-11].

CONCLUSIONS AND FINAL REMARKS

On behalf of experimental investigations, we can draw the following conclusions:

The fact that the first – calves of group A have better growth rate and high milk yield in comparison of group B clearly speaks of positive biological and economical efforts during their feeding with maternal milk in a period of 3 months till their weaning.

The birth weight and the growth rate are having a significant influence of the improvement of the milk production during the first lactation.

Milk production of the first-calving dairy cows of group A and group B differs in milk liters during the first month of lactation, in addition of group A , where there is a difference in milk production of 12 liters of milk in comparison with first – calveing dairy cows of group B.

The statistical calculation between the after birth weight of the female calves of group A and B and their milk production during their first month of lactation got coefficient of contingency - correlation of group A (r =0.62) and correlation group B (r =0.79) with which can be concluded that these two parameters are strongly correlateed .

According to the invoice of the correlations of group A and group B body masses during their 6^{th} measurement and milk production, the coefficient of contingency - correlation of group A (r =0.85) and group B (r =0.88) with which can be concluded that these two values are strongly correlated .

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