

## **Influence of organic mineral supplement MultiMix on the calving interval in dairy cattle**

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### **Abstract**

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The aim of the study was to investigate the effect of MultiMix supplement on the calving interval in dairy cattle. The production experiment was performed in the Experimental base of the Agricultural Institute – Stara Zagora with two groups of 15 lactating cows each (one experimental and one control) between May and July 2019. Groups were fed rations balanced with regard to milk productivity and body weight of animals. The supplement MultiMix was added to the water of experimental cows in line with recommendations of the manufacturer. Evaluation of unbiased statistical values for the effect of MultiMix supplement with regard to specific studied factors was done by Principal Component Analysis (PCA). The model included other factors as well – age, milk fat to milk protein ration, and daily milk yield (kg). A statistically significant between-group difference was found out in cows, as those supplemented with the organic mineral supplement MultiMix had a longer calving interval (by 39.65 days), higher daily milk yield (by 4.12 kg), and higher milk fat/protein ratio (by 0.10). Weak positive correlations were found out between milk fat/protein ratio and all other parameters – from 0.116 to 0.166. Weak negative relationships were identified between calving interval and milk yield (-0.067), as well as between milk yield and age of cows (-0.079). The strongest correlation was found out between cow age and calving interval duration. Additional, more prolonged investigations are necessary to evaluate the effect of the tested organic supplement on reproductive performance of cows.

*Keywords:* organic supplement; reproductive performance; dairy cattle; calving interval

### **Introduction**

The effect of reproduction traits on profitability in dairy cattle farming is essential (Ojha et al., 2018). The efforts to reduce the number of operational days in operation and calving intervals are economically justified (Dayyani et al., 2013). The calving interval is the best index of reproductive efficiency in dairy cattle.

Ahuja et al. (2017) have done a detailed analysis of the influence of macro- and micronutrients on reproductive performance of animals. Reproductive efficiency of an animal is an important factor determining the success of a dairy farm. Essential minerals are classified into macro elements (Ca, P, K, Na, Cl and Mg) and trace elements (Cu, Co, Se, Mn, I, Zn, Fe, Mo and Cr) depending on their amounts (NRC, 1989). Trace elements are also important for the reproductive health (Chester-Jones et al., 2013) – these are copper (Cu), manganese (Mn), and zinc (Zn). The

adequate concentration of trace elements helps achieving better conception rates (Rabiee et al., 2010). Trace elements improve reproductive traits in cattle (Kumar et al., 2011; Grace & Knowles, 2012). They play an important role in animal physiology of reproduction, and any disequilibrium in the latter causes various problems resulting in reduced reproductive efficiency. Therefore, an adequate supplementation with trace elements and their utilisation by various metabolic functions, including reproduction and growth, is necessary. Often, the correction of impaired equilibrium in mineral concentrations could improve reproductive traits and health of animals.

Mineral deficiency has a strong effect on ovarian activity in ruminants (Boland, 2003). Minerals are also involved in the synthesis of hormones, needed for reproduction. An experiment has shown that animals that received the supplement Bioflex exhibited higher first service conception rates compared to non-supplemented animals.

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The author reported that during the last years, modern cattle farming experiences real problems related to fertility, and their prevalence increased parallelly to increase in milk yield. In conclusion, the utilisation of organic minerals which have beneficial effects and a broad spectrum of application in ruminants was recommended – more efficient production, higher quality of milk and improved reproductive performance.

In order to improve production results from dairy cattle farming, the rations should contain the main nutrients. Ca and P play a primary role for the fertility of animals (Ojha et al., 2018). Uniyal et al. (2018) outlined that trace elements had an essential positive effect on fertility being necessary for the synthesis of reproductive steroid hormones and for the optimum function of cell enzymes involved in reproductive efficiency. The regular provision

of these elements in animal rations is very important for their reproductive health.

During the last years, new products representing organic minerals as acetates have appeared on the market, such as “MultiMix”. No experiments have been carried out in the country to evaluate this new product in dairy cows.

The aim of the study was to investigate the effect of MultiMix supplement on the calving interval in dairy cattle.

## Material and Methods

The production experiment was performed in the Experimental base of the Agricultural Institute – Stara Zagora with two groups of 15 lactating cows each (one experimental and one control) between May and July 2019.

Groups were fed rations balanced with regard to milk productivity and body weight of animals. The supplement MultiMix (liquid organic mineral complex containing – Table 1): and was added to the water of experimental cows in line with recommendations of the manufacturer.

**Table 1. Liquid organic mineral complex containing**

Mineral	mg/l
FeAcetat:	20.000 mg/l
MnAcetat:	20.000 mg/l
ZnAcetat:	20.000 mg/l
CaAcetat:	16.000 mg/l
MgAcetat:	8.000 mg/l
PAcetat:	8.000 mg/l
NaAcetat:	5.000 mg/l
CuAcetat:	5.000 mg/l
Cl:	1.250 mg/l
Calodat:	500 mg/l
SeAcetat:	15 mg/l
KAcetat:	10 mg/l

### Scientific hypothesis

The scientific hypothesis relied on the fact that the calving interval depended on numerous factors: age of the animal, milk fat to protein ratio, daily milk yield etc. Most of these factors were interrelated at a different extent.

### Statistical analysis

Evaluation of unbiased statistical values for the effect of MultiMix supplement with regard to specific studied factors was done by Principal Component Analysis (PCA). The model included other factors as well – age, milk fat to milk protein ration, and daily milk yield (kg).

Additionally, statistical significance of differences in these parameters was assessed, and correlation analysis was made. These tests were done by means of SYSTAT 13 sta-

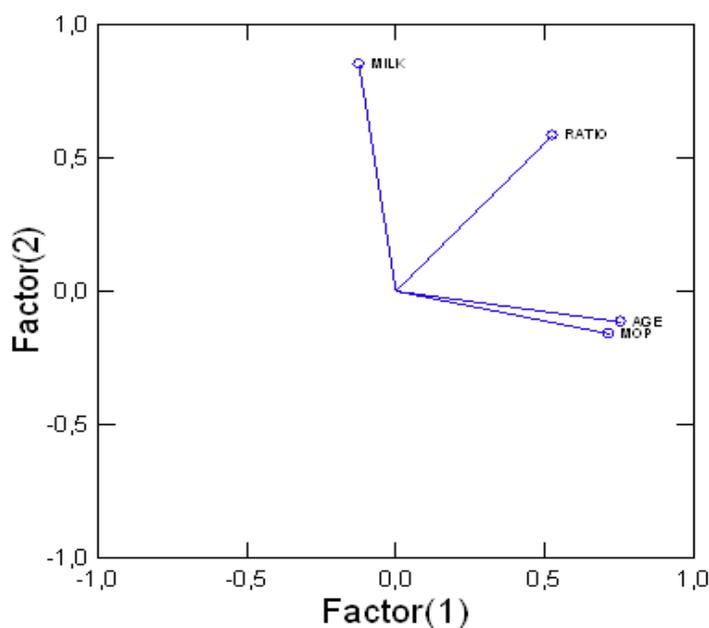
tistical software.

## Results and Discussion

The application of Principal Component Analysis (PCA) has identified the effect of two main factors that influenced the studied parameters. Positive values were demonstrated for both factors in milk fat/protein ration (Table 2, Fig. 1). The effect of factor 1 on the calving interval and age was positive, as well as the effect of factor 2 on daily milk yield. The effect of factor 2 was negative with respect to two parameters: calving interval and age of animals. Fig. 1. depicts the synergic action of calving interval and animal age.

**Table 2. Factors from the PCA analysis for the studied indicators**

	Factor 1	Factor 2
Calving interval	0.715	-0.161
Age in days	0.756	-0.116
Ratio – fat/protein	0.526	0.584
Milk yield	-0.123	0.850

**Fig. 1. Factor Loadings Plot****Table 3. Significance of differences between the indicators for experimental and control groups**

Variable	Group	Average	Mean Difference	95,00% Confidence Interval		t	df	p-Value
				Lower Limit	Upper Limit			
Ratio – fat/protein	1	1.27	0.10	0.03	0.17	2.74	199.59	0.007
	2	1.17						
Calving interval	1	437.81	39.65	20.96	58.36	4.19	121.63	0.004
	2	398.16						
Milk yield	1	29.96	4.12	2.78	5.47	6.05	170.91	0.000
	2	25.84						

Table 3 shows the presence of high statistically significant differences between experimental and control groups for all studied parameters.

It could be seen that average milk fat/protein ratio was more favourable in supplemented cattle (0.10), close to recommended value of 1.27. It could be affirmed that studies showed an optimum health status, as the commended parameter is considered a good and inexpensive indicator for the presence of acidosis or ketosis. It should be noted that the daily milk yield was higher by 4.12 kg on the average too, which should have a negative influence by decreasing the fat/protein ratio in milk consequently to the stress exerted by impaired energy balance related to high milk yields. Our results are comparable to those reported by Vlcek et al., (2016), namely that fat/protein ratio had a negative impact on milk yield and was associated to risk from acidosis and ketosis.

Higher values of the calving period were found in the experimental group compared to the control group. Nieuwhof et al., (1989) affirmed that as the number of lactation increased, average calving intervals in days increased as well; the calving interval in Holstein cattle

varied from 393 days (after second lactation) to 405 days (after 6<sup>th</sup> lactation). Dick Wallace (2019) demonstrated that optimum calving interval was between 12 and 13 months depending on the average milk yield of the herd (8 000 to 9 000 kg).

Lower calving intervals were reported by Hare et al. (2006) in Brown cattle whose calving interval was 406.7 days, and in Holstein population – 403.6 days. The authors showed that cows from both breeds in 6<sup>th</sup> and 7<sup>th</sup> lactation had the longest calving intervals. Shorter calving intervals were established by McManus et al., (2011) – 401.25 days.

Our results agreed with those reported by other researchers as the effect of milk yield on calving interval was concerned. Österman (2003) showed that cows with higher milk yield had calving intervals of 18 months. Cows with 18-month calving interval in their second lactation had a longer lactation period and significantly shorted dry period compared to the first lactation. The author also concluded that high milk yield combined with reduced calving interval resulted in problems in the beginning of lactation and poor utilisation of the high-yielding potential of cows, hence in shorter production life.

**Table 4. Correlations between the studied indicators**

Pearson Correlation Matrix				
	Ratio – fat/protein	Calving interval	Milk yield	Age in days
Ratio – fat/protein	1.000			
Calving interval	0.120	1.000		
Milk yield	0.116	-0.067	1.000	
Age in days	0.166	0.260	-0.079	1.000

Weak positive correlations were found out between milk fat/protein ratio and all other parameters – from 0.116 to 0.166 (Table 4). Nishiura et al. (2015) also observed weak positive correlation in Holstein cows. On the contrary, Vlcek et al. (2016) reported weak negative correlation between milk fat/protein and milk yield: -0.120, whereas Satola & Ptak (2019) noted a strong negative genetic correlation in first-lactation cows (-0.52).

Weak negative correlations were identified between calving interval and milk yield (-0.067) as well as between milk yield and age of cows (-0.079) – Table 4. The highest correlation coefficient was detected between calving interval and age, which is expected having in mind that as age increases, the ovarian capacity is largely depleted, leading to reproductive problems. This was confirmed also by Boland (2003), affirming that the mineral deficiency had a strong effect on ovarian activity in ruminants. Minerals are also involved in the synthesis of reproductive hormones. The author showed that recently, modern cattle farming experienced real problems with fertility which were aggra-

vated as milk yield increased. Finally, the use of organic minerals with beneficial effects and a broad spectrum of application in ruminants (more efficient production, better milk quality, improved reproductive efficiency) was recommended.

In conclusion, it can be stated that the effect of the application of such an organic supplement in dairy cows can be established after a complete physiological cycle of the herd life of cows - dry period, pregnancy, lactation. This process can be influenced by various genetic and environmental factors that affect the productivity of animals and their reproductive capacity.

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## Conclusions

A statistically significant between-group difference was found out in cows, as those supplemented with the organic mineral supplement MultiMix had a longer calving interval (by 39.65 days), higher daily milk yield (by 4.12 kg), and higher milk fat/protein ratio (by 0.10).

Weak positive correlations were found out between milk fat/protein ratio and all other parameters – from 0.116 to 0.166

Weak negative relationships were identified between calving interval and milk yield (-0.067), as well as between milk yield and age of cows (-0.079).

The strongest correlation was found out between cow age and calving interval duration.

Additional, more prolonged investigations are necessary to evaluate the effect of the tested organic supplement on reproductive performance of cows.

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