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RESEARCH ON THE IMPORTANCE OF UREA AT DAIRY COWS AND ITS DYNAMICS

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Abstract

The present research proposed to present the dynamics of urea in Holstein cows milk (as ml/dl), in order to evidence and optimize the main factors affecting this parameter. Large amount of data, including Holstein farms along the whole country was included in the study. Statistical results proved that the feeding level of protein is a main factor influencing milk urea content. Protein intake is highly related to milk market price, therefore large differences in milk urea were revealed between hot and cold season (from 40 mg/dl in the hot season to 18 mg/dl in the cold season). Relation between milk urea level, reproduction indices and the productive life was also studied. The most affected indicator by urea excess was the calving – interval (39 mg/dl – CI of 435 days). As a result, we recommend an interval between 22 – 32 mg/dl, in order to optimize milk yield and quality, as well as the reproductive parameters and longevity.

***Key words**: dairy cows, Holstein, milk production, reproduction, urea.*

INTRODUCTION

Milk urea level is a high valuable indicator, providing relevant information, an indicator that can be easily obtained from milk analysis. Since the dairy sector arouses worldwide interest, large amount of information is available on this subject. Several factors are influencing milk urea level: breed (Rodriguez et al., 1997), parity (Broderick & Clayton, 1997), body weight (Kohn et al., 2001), milk yield (Godden et al., 2001), fat and protein content, DIM, and month of the year. However, feeding is the main influencing factor, more precisely the protein intake, therefore protein content from the feeding should be optimized.

If milk urea level has a low value, we can conclude that the cow is poorly fed, leading to incomplete expression of the genetic potential of animals. Otherwise, if milk urea level of is too high, we deduce that the cows will be exhausted prematurely, that the reproduction parameters will be affected, but first of all that the feed is not economical.

Also, milk urea level is used to monitor the nutritional status of dairy cows and reduce nitrogen emissions to the environment (Samore et al., 1996; Spek et al., 2013). This paper aims to identify optimal values that combine the production with the welfare of the animals, in an increased economic efficiency.

MATERIALS AND METHODS

The present paper is based on large amount of data, obtained from Holstein Breeding Association (ACV Holstein Ro) official control production (COP). Urea content has been measured as mg/dl.

Therefore, about 10.300 Holstein dairy cows from 15 herds were been included in the survey. Lactation stage, rank, seasonal effect has been included in the research.

The season is an essential factor affecting milk urea content, since milk market is strongly correlated with seasonal milk yield in Romania. Statistical procedure used standard methods. Therefore, milk urea level (MUL) has been correlated with productive and reproductive parameters (milk yield – L305, kilograms of fat on standard lactation - FY, kilograms of protein on standard lactation - PY, calving interval - CI, service life - SL), using the correlation formula:

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

RESULTS AND DISCUSSIONS

In order to analyze and interpret all the hypotheses the results obtained from 15 farms, located all over the country were statistically processed. In order to determine the correlation, the annual averages for the year 2021 of the milk urea level for all farms were calculated.
First of all, we will present the results obtained from the correlation of MUL with the productive parameters.

Table 1. Statistical analysis between MUL and milk yield (L305)

Specification	Average of MUL	Milk yield - L305
Farm 1	40	8369
Farm 2	25	10523
Farm 3	22	10643
Farm 4	31	9801
Farm 5	28	8771
Farm 6	25	13098
Farm 7	26	9838
Farm 8	25	9889
Farm 9	31	10469
Farm 10	19	8125
Farm 11	14	8358
Farm 12	37	9560.1
Farm 13	25	12678
Farm 14	18	7599
Farm 15	30	10789
X + Sx	26.4 ± 1.77	9900.69 ± 405.75
S	6.87	1571.48
V%	26.04%	15.87%
r	0.12	

Based on this table we can extract the following information: Farm 1, with the highest average of MUL – 40 has an average of 8,369 kg of milk and Farm 11, with the lowest average of MUL – 14 has recorded 8,538 kg of milk average on standard lactation. Almost the same quantity of milk, but with a difference of 26 mg/dl of MUL. Of course, there are many factors that can influence the milk yield, not only the MUL.
There are 4 farms that registered the same average of MUL (Farm 2, Farm 6, Farm 8 and Farm – 13, 25 mg/dl), but with significant differences regarding milk yield, 3,209 kg between Farm 6 and Farm 8. The correlation between MUL and milk yield is very weak, r = 0.12. According to others research milk yield is positively related to MUL (Godden et al., 2001), but in the same time others reported a negative relationship (Ismail et al., 1996; Trevaskis and Fulkerson, 1999).
In table 2 it is obvious that the highest FY average, 593 kg is registered at Farm 13, farm that has an average of 25 MUL. Very interesting is the fact that the lowest average of FY is found at Farm 5, farm with a higher average of MUL that Farm 13, 28 mg/dl. Relating only on this facts we will be tempted to consider that between MUL and FY is no correlation, or a negative one. Continuing study, based on the correlation result, r = 0.29, we find something quite the opposite. The correlation between these two parameters is a positive one, of course, a weak one, but however more correlation that MUL and milk yield. Positive correlation between MUL and FY were reported in others studies (Wood et al., 2003).

Table 2. Statistical analysis between MUL and FY

Specification	Average of MUL	FY
Farm 1	40	448
Farm 2	25	396
Farm 3	22	428
Farm 4	31	396
Farm 5	28	324
Farm 6	25	492
Farm 7	26	452
Farm 8	25	376
Farm 9	31	502
Farm 10	19	388
Farm 11	14	380
Farm 12	37	470
Farm 13	25	593
Farm 14	18	340
Farm 15	30	385
X + Sx	26.4 ± 1.77	424.66 ± 18.05
S	6.87	69.92
V%	26.04%	16.46%
r	0.29	

Table 3. Statistical analysis between MUL and PY

Specification	Average of MUL	PY
Farm 1	40	337
Farm 2	25	348
Farm 3	22	373
Farm 4	31	336
Farm 5	28	303
Farm 6	25	424
Farm 7	26	350
Farm 8	25	318
Farm 9	31	354
Farm 10	19	303
Farm 11	14	282
Farm 12	37	326
Farm 13	25	463
Farm 14	18	264
Farm 15	30	366
X + Sx	26.4 ± 1.77	343.13 ± 13.23
S	6.87	51.23
V%	26.04%	14.93%
r	0.22	

Also, in the case of the correlation between MUL and PY, as between MUL and FY we obtain a weak, but positive result, r = 0,22. Same results was obtained in other study (Stoop et al., 2007).

After the analysis of association between MUL and productive parameters the work continues by studying the relationship between MUL and reproductive parameters, and also regarding the service life (the age of reforming the cows). A negative association between reproductive parameters and high dietary protein levels have been reported by many studies (Butler et al., 1996; Chaveiro et al., 2011).

The reproductive parameter studied was calving – interval, starting from the premise that a higher MUL will determine a higher CI. A significant negative effect of MUL on the fertility at high-yielding dairy cattle was reported in a study (Siatka et al., 2020). In the same time, previous studies analyzing the correlation between MUL and conception find out that there is a negative effect of high MUL at or only after AI (Butler et al., 1996; Melendez et al., 2000).

Table 4. Statistical analysis between MUL and CI

Specification	Average of MUL	CI
Farm 1	40	449
Farm 2	25	424
Farm 3	22	399
Farm 4	31	423
Farm 5	28	405
Farm 6	25	390
Farm 7	26	396
Farm 8	25	392
Farm 9	31	400
Farm 10	19	412
Farm 11	14	415
Farm 12	37	416
Farm 13	25	417
Farm 14	18	407
Farm 15	30	414
X + Sx	26.4 ± 1.77	410.60 ± 3.89
S	6.87	15.08
V%	26.04%	3.67%
r	0.44	

The present study provides the expected results. Between MUL and CI is a reasonable correlation, r = 0.44. Based on these results we can say that MUL has a bigger influence on CI than on PY for example, a double one, unfortunately, a higher CI is not desired. Also, a negative effect of MUL on conception rate at first service at dairy cows was reported (Hojman et al., 2004). Similar results were obtained in by Butler et al., 1996, they concluded that concentrations of MUL> 19 mg/dl are associated with decreased pregnancy rate. In our study, the higher CI is registered at the Farm 1, 449 days. This result is in association with a very high MUL 40 mg/dl. Farm 6, that registered the shortest CI, have a MUL of 25 mg/dl. Despite these facts there are still some uncertainly information regarding the effect of high urea on reproduction occurs mostly during the period before, surrounding, or after AI (Hammon et al., 2000; Leroy et al., 2008b). In the same time, we have to admit that are studies that found that the protein intake has no effect on fertility or conception, but is highly correlated with milk and blood urea.

Table 5. Statistical analysis between MUL and SL

Specification	Average of MUL	SL
Farm 1	40	1219
Farm 2	25	1325
Farm 3	22	1383
Farm 4	31	1518
Farm 5	28	1466
Farm 6	25	1205
Farm 7	26	1801
Farm 8	25	1459
Farm 9	31	1404
Farm 10	19	1922
Farm 11	14	2973
Farm 12	37	1612
Farm 13	25	1569
Farm 14	18	2391
Farm 15	30	1826
X + Sx	26.4 ± 1.77	1671.53 ± 122.23
S	6.87	473.38
V%	26.04%	28.32%
r	-0.65	

The lifetime of an animal is defined by the biological longevity and the productive longevity (Gavrila et al., 2015).

The results are very clear, MUL is undoubtedly associated with the service life. The correlation is negative and high, r = -0.65, from all parameters studied this is the most influenced one by the MUL. Of course, other factors are also contributing in determining the time when the cows are reformed, but surely MUL by early exhaustion of the body is implicated.

Another object of study was represented by urea level dynamics depending on the season. In some cases, it have been notice huge differences between the MUL registered in a summer month compared to a winter one, for example in Farm 13 in July MUL was 40 mg/dl and in December only 19. In the same time several farms have the opposite situation, higher values of MUL in the cold season and lower in the hot season. Another paper that studied this subject reported the lowest MUL in November - 11.8 mg/dl, with a maximum in June – 18.1 mg/dl (Hojman et al., 2004). The whole situation regarding the dynamics of MUL depending on the season is presented in the table 6.

Table 6. MUL dynamics depending on season

Specification	MUL/cold season	MUL/hot season
Farm 1	38	43
Farm 2	26	24
Farm 3	23	22
Farm 4	30	33
Farm 5	29	27
Farm 6	25	26
Farm 7	31	21
Farm 8	26	24
Farm 9	26	24
Farm 10	17	21
Farm 11	13	16
Farm 12	37	37
Farm 13	17	32
Farm 14	14	20
Farm 15	30	30
X + Sx	25.36 ± 1.96	26.62 ± 1.85
S	7.59	7.17
V%	29.94%	26.92%

At Farm 7 can be observed a difference of 10 mg/dl between the two seasons, higher value registered in the cold one. A difference of 15 mg/dl is present at Farm 13, but the higher value is the warm season.

However, the average is almost equal 25.36 mg/dl in the cold season, respectively 26.62 in the hot season.

Therefore, the hypothesis that the feeding is done differently depending on the season, in order to the milk market is not true, or we can say that it is true in singular cases.

The main results obtained from the study are summarized in Figure 1.

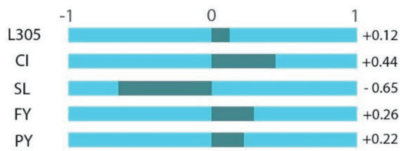

Figure 1. Correlation between milk urea level and different parameters

CONCLUSIONS

The MUL is positive correlated with the milk yield, but in small measure, r = 0.12. So, a high protein diet is not economical in order to increase milk production.

Also, a positive association between MUL and milk quality (the amount of fat and protein) was found, greater than that with milk yield. Regarding the correlation between MUL and reproductive parameters, more exactly the CI, the result are significant. As higher is the MUL a longer CI is expected.

The biggest association was registered between MUL and SL, r = - 0.65. So, if the farmer wants that his cows to be in farm for long time, he will need to pay close attention to this indicator.

No significant differences were found between MUL in the cold season and MUL in the warm season.

Therefore, we recommend an interval of 22-32 mg/dl, in order to maintain the reproductive parameters to a satisfactory level and in the same time to optimize the milk yield and quality. A similar study, recommended for cattle management in Germany, France and Austria a range between 15-30 mg/dl (Glatz – Hoppe et al. 2020).

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