

## **Illumination levels in milking parlor in dairy cows freestall housing system**

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### **Abstract**

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The survey was conducted in the milking parlor of dairy cattle farm with a capacity of 500 Holstein-Friesian cows. Milking parlor was a double-8 “herringbone” type. The premises had no windows, and the roof structure was constructed of glass. The milking parlor lighting was of fluorescent luminaires. The illumination level was reported three times during each milking (at the beginning, in the middle and at the end of the milking), with the measurements repeated during the morning, midday and evening milking. The illumination level was measured at the level of the milkers' hands during work, using a Lutron EM-9300SD. The highest average value of illumination level was reported during the spring season for midday milking 1030.3 lux. The lowest reported average value of the illumination level was registered during the winter season at evening milking 80 lux. It was found that the reporting season and the sequential milking for the day had a statistically significant effect on the illumination level in the milking parlor.

*Keywords:* illumination level; dairy cows; milking parlor; free stall

### **Introduction**

Microclimate and lighting conditions are very important because they often are the basis for various occupational diseases (Frazzi & Lodigiani, 1996), but they are also related to the quality of the activities performed. The authors indicate that not in all farms, natural and artificial light as well as the microclimate are satisfactory. Artificial lighting generally works well, but needs better maintenance. In none of the farms, however, the authors found no presence of emergency lighting. The level of illumination in the building under the conditions of tie-housing production system and in milking parlor is essential on the one hand for the normal course of milking as a process, and on the other hand it should not be forgotten that it is a matter of production of raw material, which is basis of various food products. It is necessary to observe the condition of the milk milked directly from the animals in order to ensure the safety of the obtained product, also good lighting is a prerequisite for better washing and cleaning of the teats before milking and therefore lower risk of milk contamination.

People working with animals need enough light to cope well with the activities they perform and to react on time to the signals of the cows in case of any problems that are essential for good management. In general, the recommended

values of 100 to 160 lux are sufficient for this, but in areas where it should be seen better, such as milking parlor, maternity pen the recommended illumination level is 270 to 320 lux. Working in a well illuminated building is always more pleasant than in a dark and gloomy one (Site Dairy Logix).

In direct sunlight, the light intensity is approximately 100,000 lux, but on a cloudy day it decreases to about 5,000 lux. It is important to note that lux is a unit of measurement that characterizes the brightness of light perceived by humans, but there is no firm opinion that this also applies to animals (Starby, 2006).

In poor lighting outside the night hours, as shown by Josefsson et al. (2000), also occur trivial incidents with staff (slips and falls) during work in the barn. These injuries can sometimes be fatal. Good lighting helps workers detect obstacles and slippery areas. Eventually people feel better in a lighted workplace and can therefore improve the quality of their work. According to the American Association of Agricultural and Biological Engineering Standards (ASAE, 2006), the recommended value for the level of illumination in a milking parlor, in milking pits and near the udder is approximately 540 lux. This illumination level is sufficient if different deviations from the normal color and consistency of the milk appear, to be noticed and timely measures to be taken to fix the problem.

These requirements must be taken into account at the conditions of milking, regardless of the production system used - milking in tie stall housing or in a milking parlor. Lighting parameters are one of the important factors in the hygienic evaluation of buildings for dairy cows. Good lighting is necessary for the normal flow of technological activities and for provision of hygienic and safe working conditions for employees working in the dairy cattle farming. In the end, a well illuminated workplace facilitates workers' activity and is safer for them (Miteva, 2012).

The aim of the study was to determine the level of illumination in the milking parlor during milking at different time throughout the day in the various seasons and to determine whether there is a risk of damage to the milker's eyesight and to the quality of the manipulations they perform during the milking.

## Material and Methods

The survey was conducted in the milking parlor of dairy

cattle farm with a capacity of 500 Holstein-Friesian cows. Milking parlor was a double-8 "herringbone" type. It had no windows, and the roof structure was constructed of glass. The milking parlor lighting was of fluorescent luminaires. The milking installation has been in operation for 10 years. The milkers employed on the farm were four, and they were working two per shift. All the milkers on the farm were male, aged 40 to 55 years. The duration of one milking was within 2.5 hours, three times a day. Milking in the morning begins at 5:00 h, at noon at 12:00 h and in the evening at 18:00 h.

The illumination level was reported three times during each milking (at the beginning, in the middle and at the end of the milking), with the measurements repeated during the morning, midday and evening milking. These measurements were carried out every month for one calendar year. A change in illumination levels depending on the milking sequence and season was found. The illumination was measured at the level of the milkers' hands during work.

The illumination level in the milking room was reported using a Lutron EM-9300SD (Fig. 1.)



Figure 1. Lutron EM-9300SD

For a basic statistical processing of the data a package MS Excel was used, and for obtaining the average values, errors, and analysis of variance, the corresponding modules of STATISTICA of StatSoft (Copyright 1990-1995 Microsoft Corp.)

The following model was used to assess the influence of the controlled factors:

$$Y_{ijkl} = \mu + S_i + M_j + P_k + e_{ijkl}$$

Where:  $Y_{ijkl}$  was the dependent variable (illumination level);  $\mu$  was the mean for the model;  $S_i$  was the effect of the season of reporting,  $M_j$  was the effect of the sequential milking for the day,  $P_k$  was the effect of the sequential reporting during milking and  $e_{ijkl}$  was the effect of the uncontrolled factors (error).

By analysis of variances (ANOVA) for the model were obtained by classes of the fixed factors the means of least squares (LSM).

## Results and Discussion

Table. 1 presents average values and standard deviation of the level of illumination in the milking parlor by milking sequence and reporting season. It was normally that the

milking parlor had the highest level of illumination during midday milking, when the sun was highest in the sky and illuminating directly the milking parlor, on which roof structure was constructed of glass. Summer and spring had the highest reported values of illumination compared to the other two seasons (winter and autumn). This was normal since those seasons are characterized by a most intense sunshine. The highest average value of illumination was reported during the spring season for midday milking 1030.3 lux. The lowest reported average value of the illumination level was registered during the winter season at evening milking 80 lux.

The highest reported max value was registered at the same time 2360 lux in the spring season at midday milking, and the lowest reported min value of 78 lux for the winter season at evening milking. Papez & Kic, (2015) in their study found for the summer season values of illumination levels from 1384 to 1502 lux, which were much higher than we found for this season 866.1 lux. The same authors reported values for the winter season from 295 to 325 lux, which were considerably lower than the values found by us for the same season - 926.7 lux. The visual comfort of the indoor environment is characterized by illumination intensity. Lighting is divided into physiological and working

**Table 1. Average values and standard deviation of the illumination level in the milking parlor by sequential milking and season of reporting**

Milking	Number N	Illumination level (lux)			
		X ± Se	SD	Min	Ma <sub>x</sub>
Summer					
Morning	9	211.8±25.5	76.5	120	341
Midday	9	866.1±60	180	620	1159
Evening	9	288.4±32.2	96.5	180	513
Autumn					
Morning	6	142.5±15.8	38.7	100	212
Midday	6	675.7±128.9	315.7	363	1112
Evening	6	126.3±15.5	38	91	165
Winter					
Morning	3	82.3±1.86	3.2	80	86
Midday	3	926.7±31.7	54.9	866	973
Evening	3	80.7±1.76	3.06	78	84
Spring					
Morning	9	247.9±60.4	181.3	86	650
Midday	12	1030.3±206.79	716.35	192	2360
Evening	12	306.8±39.4	136.4	184	597

Physiological lighting is necessary primarily for the biological well-being of the organism. Working lighting creates favorable working conditions and also possibility for hygienic assessment of environment (Dolezal et al., 2004; Kunc et al., 2007; Chloupek & Suchy, 2008). According to the authors, for the cows both types of lighting are obligatory - physiological and work lighting at level of 60 lux. For the milking parlors are required working lighting at a level of 200 lux (Dolezal et al., 2004). Comparing

the given recommendation for work lighting with the illumination levels obtained by us, it was evident that for the winter season for the morning and evening milking the reported values were well below the recommended 82.3 and 80.7 lux, respectively. The same applies to the autumn season during these milkings - here the values were higher, but did not reach the recommended - 142.5 and 126.3 lux, respectively. In our country there are no regulations concerning the level of illumination in this type of activity.

From the analysis of variance for the influence of the controlled factors on the levels of illumination in the milking parlor (Table 2) it was found that the reporting season and the sequential milking for the day had a statistically significant effect. The effect was such because in all seasons the natural illumination was different depending on

the season, and because during the day the natural light was changing as the day progresses.

The mean values of the illumination level depending on the season showed that the autumn and winter seasons had the lowest reported values (Fig. 2).

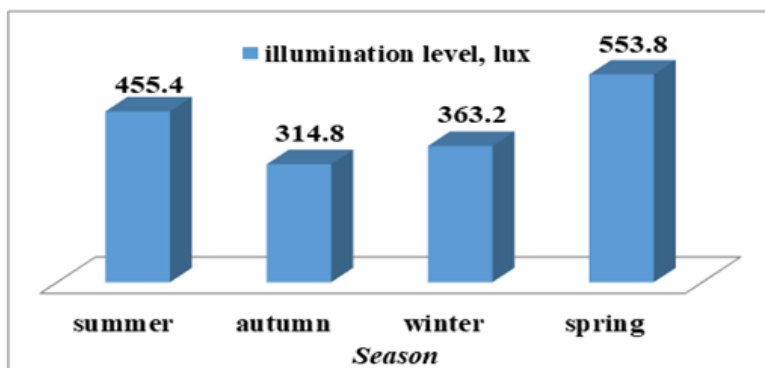


Figure 2. LS–mean values for illumination level depending on season of reporting

During these seasons, normally the natural light is much lower in intensity than the other two seasons (spring and summer). It is necessary the artificial lighting to be adjusted to compensate for the lack of natural light. In

accordance with the recommendation of 200 lux in all seasons there were average levels of illumination above this value.

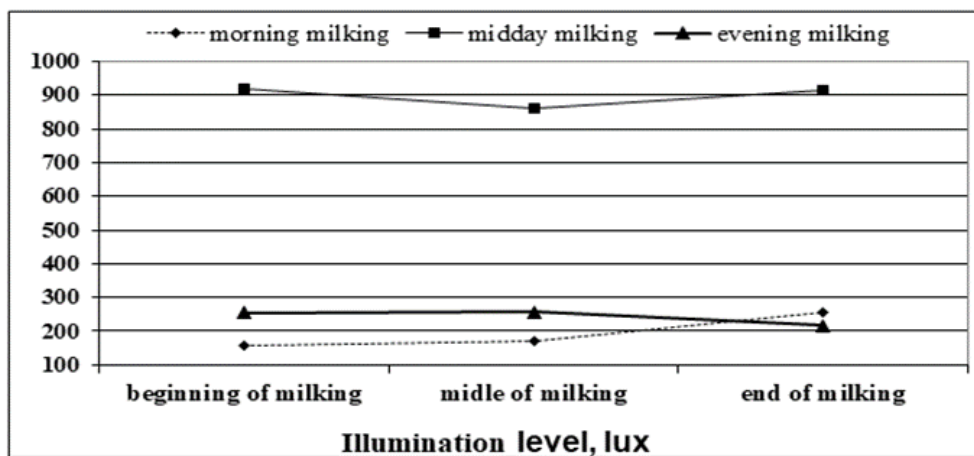


Figure 3. Level of illumination depending on the sequential milking for the day and the sequential reporting during milking

Fig. 3 presents the illumination level depending on the sequential milking for the day and the sequential reporting during milking. In the morning the lowest levels of illumination were reported and towards the end of milking the illumination increased as the natural illumination increased with the progress of the day. The same trend was

observed in midday milking with increased illumination levels towards the end of milking. In the evening milking the opposite tendency was observed, towards the end of the evening milking the level of illumination decreased. This was attributed to the end of the day and the sharp decrease in natural light that comes from outside.

## Conclusion

The study revealed very low levels of illumination during the autumn and winter seasons. It is necessary the artificial lighting to be corrected to respond adequately to the needs of the work process.

It is necessary to create a regulation that would regulate the levels of lighting in the milking parlors in Bulgaria,

as such regulation is available in other countries of the European Union. Not a small number of people are engaged in this activity and in addition it is a matter of food production and it is necessary to observe the conditions under which this product is produced in order to ensure its quality and safety.

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