LIGHT IN THE STABLE FOR DAIRY COWS

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The light is one of the factors that significantly affect vital signs and behaviour of the animals in the stable. The trend of our time is to increase the yield of high-yield dairy cows and consequently increase the requirements for optimal animal welfare in the stable. Currently, farmers trying to use adequately the most available technical means in the stables, thus improve the overall microclimate. The lighting optimizes the state of physiological functions which affect the health of the animals, their progress, growth and average milk yield. This study was carried out in a commercial dairy farm located in the Central Bohemia region of the Czech Republic. In the experimental stable there was measured the light using a digital luxmeter HD 450 during 2014. Data of the average milk yield were obtained from the farm records. The aim of this study was to determine how the measured values of light affect the average milk yield of dairy cows in the stable.

Keywords: light, dairy cow, milk production, stable

INTRODUCTION

Microclimate is an air in more or less closed area of the stable. It consists of a number of individual factors. One of the factors measured in the stable environment, which affects the environment in the barn and living standards is lighting, and solar radiation.

Light generally represents the visible part of the solar spectrum. The spectrum of solar radiation is divided into two wavelength regions. The first part consists of cosmic radiation, which to a certain extent weakens the Earth's atmosphere. The second area consists of non-ionizing radiation, which affects the distribution of energy between the Sun, the Earth and atmosphere. Thus becoming a controlling climatic factor (Šoch, 2005).

Solar radiation is the source of heat and light and is one of the factors which has an immediate impact on welfare of livestock. The role of lighting is in stable areas of considerable importance, and should not be underestimated (Hutla, 1998). Its intensity and duration may affect animal performance. In some cases, it uses for prevention and treatment of certain diseases (Prentice, 2005).

Cattle perceives light intensity sensitively. Tests have shown that cattle prefer places that are illuminated in front of the places where is dark. Up to 90 % of stabled dairy cows preferred the bright place in artificial level of 200-250 lux, before the section with natural light mode (Doležal, Bílek, 2001). Values lower than 50 lux cows already perceive as darkness (Zejdová, 2014).

The ratio of alternating light and relative dark affects the lives of animals at the level of the circadian rhythm (circadian), with relation to the seasonal rhythm (changing seasons).

Every day is appropriate to expose dairy cows with the light for 15 to 16 hours in production barns. Insufficient daylight of stable getting worse health condition of the herd (Doležal, 2013; Rendic, 2002; Hayes, 2007). Dahl et al. (2002) argue that increased exposure to the light reduces the secretion of melatonin. Increases the circulation of prolactin and insulin concentrations of IGF-I. Regime of a long day (16: 8) reduces metabolic disorders and due to a long-day photoperiod is possible to increase milk yield.

Aharoni et al. (2002) confirm in the research that the length of the day has a positive effect on milk production.

Production stables should meet the demands for space, surface, air and light (Doležal, Bečková, 2014). When designing buildings, it is important to follow the required ratios of the transparent window area and the floor area. The required ratios of windows and floors would to be in average 1:20 in the cattle breeding.

The light is one of the most important elements of microclimate that its presence appreciates buildings for breeding success (Šístková, Peterka, Peterka, 2010).

The correct illumination is required for security of work, maintaining cleanliness of animals, of environments and of stable equipment. Level of stable illumination is given in CSN 36 00 88 "Lighting in agricultural holdings."

Hutla et al. (2013) argue that sufficient lighting in place for feeding of dairy cows is based on the requirement of maximum feed consumption of animals. It is directly related to their milk production. The feed is so necessary to illuminate as much as possible to create its sufficient brightness to an animal the appropriate motivational impulse.

Despite these facts breeders and planners do not use sufficient scientific and technical knowledge. Especially during reconstructions of stables is light function significantly underestimated (Knížek, Staněk, Dolejš, 2012).

MATERIALS AND METHODS

During the experiment were followed the lighting in the stable and light values of ambient environment in compared with the average milk yield. Experiment was carried out in the agricultural cooperative in central Bohemia during the seven months of 2014, at regular weekly intervals. The entire experimental period was divided into the winter season, in which they were included months (January, February, and March). The second period was spring and summer with months (April, May, June, and July).

The observed object was a stable for dairy cows, which is designed as an open space with a cubicle bed. Stable is divided with feeding corridor into two halves. Each half is divided into three sections. Boxes are placed in three rows. As a litter material is being used separated manure. Stable is created with a rectangular shape covered with a gabled roof with a ridge vent slot. In side profile of the stable there are rolling sails. Longitudinal profile of the stable there is in the implementation phase of opening and installation of automatic sails with weather station.

Experiment was carried out between Holstein dairy cows. It was monitored one section, in which were located dairy cows of stage of lactation from 4 months to 5 months after calving.

The light was evaluated climatic factor. It was measured systematically in the stable at the height of 0.85 meters above the ground using a digital luxmeter Extech HD450 with a measuring range from 0 to 400,000 lux. Controlling light was measured outside the stable in outdoor environment. Light values measured at checkpoints in the stable and outside were

averaged for each month. In addition to the lighting in the stable and light intensity in the environment was observed average milk yield of dairy cows. Data on the average milk yield were taken from farm records.

Data regarding the lighting in the stable, the ambient lighting conditions, and the average milk yield were statistically analyzed and shown in Table, and then displayed using graphs.

RESULTS

The resulting correlation of influence of light intensity in the stable and in the environment on the average milk yield are shown in Table 1 and Figure 1 and 2.

In Table 1 there are shown the mutual correlation between the selected microclimatic element and milk production. Strong correlations are highlighted.

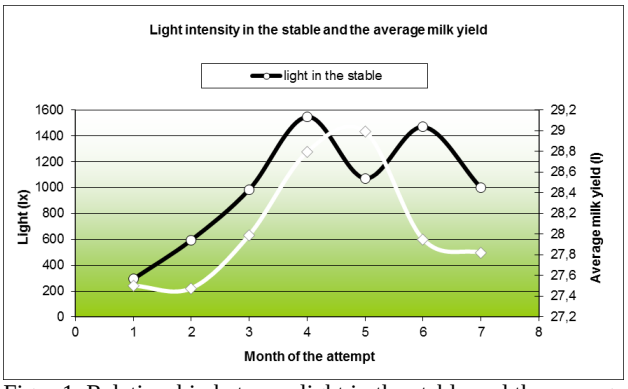
Table 1. Correlation of light intensity and the average milk production

	Light in the stable	Light in the environment	Average yield
	SUMMER		
Light in the stable	1.000	0.727	0.124
Light in the environment	0.727	1.000	**-0.591**
Average yield	0.124	**-0.591**	1.000
	WINTER		
Light in the stable	1.000	0.982	**0.881**
Light in the environment	0.982	1.000	0.776
Average yield	**0.881**	0.776	1.000

Table 1 shows that in the warmer periods of the year when the experiment was conducted, negatively correlated the average milk yield with the intensity the lighting in the environment (r = -0.591). According to this result, the intensity of ambient light should increase and milk production decrease. Conversely, exposure of lighting intensity in the stable during this period did not have such influence on milk production. The correlation coefficient had a value of (r = 0.124).

During the winter part of the experiment closely and positively correlated the light intensity of environment with the light intensity in the stable (r = 0.982). The close correlation is predictable. During winter months, the light intensity in the environment gradually increases. It prolongs the light part of the day which significantly affects the illuminated environment of stable.

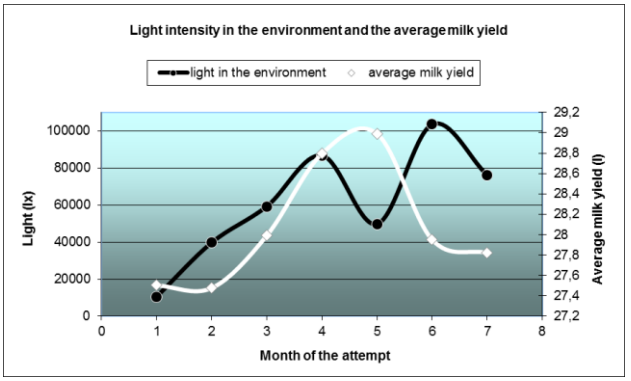
The intensity of lighting in the stable too closely and positively correlated with milk production with a value (r = 0.881). The light intensity of outdoor environment has to the average milk yield lower influence (r = 0.776). From the correlation values it is therefore evident that the average milk yield was significantly influenced by the intensity of light in the stable in winter time. Until then, the average milk yield was influenced by the intensity of light in the environment. Stable lighting so become its importance in winter time, if we want to increase milk production.



Figur 1. Relationship between light in the stable and the average milk yiel

The graph 1, which deals with the relationship between the intensity of lighting in the stable and the average milk production throughout this experiment suggests that light intensity of the stable initially positively correlated with the curve of milk production. This means that with increasing light intensity in the stable increases proportionally also the average milk yield. Simultaneously, if the intensity of lighting decreases in the stable, milk production will declines as well. From the fourth month of the experiment there was a change and expression of negative correlation, which was reflected in a comparison of stable lighting and average milk production. Hutla et al. (2013) argue that to achieve good results of milk production must be the illumination intensity in stables for dairy cows in the place of feeding at least equal to 100 lux. During this experiment reached a measured lighting data higher values. On average it was 994 lux.

Graph 2 illustrates the relationship between the intensity of light in outdoor environments and an average milk production throughout the experiment. Values plotted in the graph confirm results of correlation coefficients. In the first phase of the experiment, increased the light intensity curve well as increased milk production. From the fourth month of the experiment began to show negative correlation values. From this moment with increasing level of ambient light is slightly decreased milk production. Conversely, with decreasing light levels outside the stable milk production grew slightly.



Figur 2. Relationship between light in the environment and the average milk yield

The results confirm Dahl et al. (2002) Aharoni et al. (2002), by which the length of day can positively affect milk production. Because due to long-day photoperiod is possible to increase milk yield.

Zejdová et al. (2014) found that the intensity of lighting is closely correlated with temperature. The resulting values may therefore be justified by seasonal rhythm, a season in which the experiment was made.

CONCLUSION

The results indicate that dairy cows the production of is affected by light intensity of lighting. During the spring and summer of experiment influenced the average milk yield with negative correlation with the intensity of light in the environment. The results of the correlations show that, in this period does not have the intensity of lighting in the stable to milk production such influence. In the winter part of the experiment, the average milk production was significantly influenced conversely with light in the stable. Subsequently, the intensity of lighting of outdoor environment. Comparisons of stable lighting and of outdoor environment were found greater influence of the interaction in winter time of attempt.

The graphs show that in the winter part of the experiment with increasing light intensity increases also the average milk production. In the spring and summer of the experiment it was

the opposite. In winter, it is appropriate to put greater emphasis on appropriate and sufficient illumination of the stable.

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