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Zoo-hygienic assessment of lighting in semi-open freestall barns for dairy cows

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Abstract. *The aim of the present study was to perform a zoo-hygienic assessment of lighting (natural and artificial) in different technological zones (stalls, manure and feed alleys) in semi-open freestall barns for dairy cows. The survey was conducted over a period of one year in 3 production buildings from 3 cattle farms located in three different areas of Southern Bulgaria - Stara Zagora District, Haskovo District and Plovdiv District. The building's parameters were as follows: building No.1 - capacity 120 cows, 60.00/18.00/3.00m, 1080m^2; building No.2 - capacity 120 cows, 66.00/18.00/3.00m, 1188m^2 and building No.3 - capacity 500 cows, 90.00/45.00/3.30m, 4050m^2. The premises lighting was measured with two combined apparatuses (Lutron EM-9300SD, 0-20000 lux and PU 150, 0-100000 lux), twice a month at 10.00, 12.00, 14.00, 16.00 and 18.00h at a height of 1m from the floor of the three technology zones. Summarized for all buildings, the light level varies widely by buildings, by seasons, by hours of reporting and by technological zones with limit values between 1 and 9810 lux. In all barns the most intense was the light above the feed alleys, followed by stalls and manure alleys; by hours of reporting during the day the level of lighting above the three technological zones was higher at midday (12.00-14.00h) compared to morning (10.00h) and afternoon (18.00h). Buildings No.1 and No.2 with a smaller built-up area provide more intensive lighting over all technological zones throughout all seasons compared to building No.3 with bigger built-up area: from 7.34 to 13.8 times over stalls, from 3.22 to 5.62 times over manure alleys and from 2.79 to 8.00 times over feed alleys. In buildings No.1 and No.2 there were prerequisites at least 16 hours of day light (photoperiod) to be provided during summer, autumn and spring, while in the winter months up to 8.00am and after 6.00pm the used artificial lighting was with low intensity and cannot provide the recommended over 160 lux intensity of the light. In building No.3 during most of the day for all seasons, the level of lighting above stalls and manure alley where the animals stay the longest time, the lighting level was lower than 160 lux. The factors 'building', 'season' and 'hour of the day' had a statistically significant effect (P<0.05-0.001) on the level of lighting in the three technological zones in the studied buildings. Of the associated factors, only the combination 'season*hour of reporting' had no significant effect on the lighting in the zones above the stalls and manure alleys.*

Keywords: dairy cows, freestall barns, stalls, manure, feed alleys, lighting, assessment

Introduction

Over the past 15 to 20 years, dairy cow housing worldwide has been characterized by replacing the more extensive production systems with more intensive ones. This is related to increasing the capacity of the farms and the number of dairy cows in one building; introduction of semi-open buildings and year-round indoors housing of animals; upgrading systems to maintain optimal microclimate in buildings, etc. Milk production depends on many variables and environmental factors, which can be summarized into three groups: genetic, nutritional and animal-hygienic (determining the comfort of animals) (González-Barragán and Calzada, 2014).

Enhanced cow productivity, the provided well-being and safer working conditions make lighting an important feature of dairy cow buildings microclimate. In well-lit premises, cows move more easily through separate technological zones, pass through the entrances and exits without any hindrance, specialists and workers are better oriented, more easily and more accurately carry out animal observation and service (Harner et al., 2008). The better lighting of the premises and the exposure of the cows to the longer light day (photoperiod), 16-18 hours per day, also contribute to better health, better absorption of nutrients, increased milk productivity and better reproductive performance. It also provides longer rest (lying) periods for cows, which helps reduce the risk of lameness and easier detection of early signs of other health problems (Dahl et al., 2000; Cook, 2011; Mitev et al., 2012).

According to Buyserie et al. (2001), at night the lighting should not exceed 10 lux and there is no need to provide higher level of lighting because dairy cows do not need light to find food and water. Phillips et al. (2000) found that a certain level of illumination is required to ensure natural locomotion as dairy cows react to the reduced intensity of light with changes in locomotion. Based on these results, the authors recommend during the dark part of the day an optimum level of illumination for traffic passages ranging between 39 and 119 lux. According to Muthuramalingam et al. (2006), as a level of illumination intensity at night 5-10 lux can be used without affecting the normal physiological functions of the body. A study by Lawson and Kennedy (2001) found that at a light intensity above 50 lux, there was a tendency to reduce melatonin secretion compared to a lack of lighting (0 lux). On the other hand, older cows in the building exposed to 40-60 lux at night show no reduction in melatonin compared to 0-5 lux. In both lighting regimes, dry matter or milk yields do not differ between the two groups of cows (Bal et al., 2008).

In direct sunlight the intensity of light is approximately 100 000 lux, but on a cloudy day it decreases to about 5000 lux. It is important to note that lux is a measure unit that

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characterizes the brightness of light perceived by humans, but there is no unambiguous opinion that this also applies to animals (Starby, 2006).

Bulgaria is no exception to global trends in the development of dairy cattle farming. In recent years, many cattle-breeding farms have introduced innovative technological solutions - new dairy cattle farms were built with more capacity, loose housing production systems in semi-open barns with natural ventilation, year-round indoors housing, higher degree of mechanization and automation of production processes, etc. (Miteva et al., 2005; Gergovska et al., 2013; Dospatliev et al., 2015; Dimov et al., 2017). Similar requirements have been introduced to the reconstruction of old dairy cattle buildings. A number of indicators related to ensuring the necessary animal hygienic conditions and the well-being and comfort of animals in these new or reconstructed buildings have been taken from foreign standards and recommendations. For most of the animal-hygienic indicators there are no studies at our farms and growing conditions of dairy cows. Such was the case with one of the main factors of the microclimate in dairy farm buildings, namely the level of lighting and the duration of the daylight (photoperiod). All this gave us reason to conduct this study, the aim of which was to investigate and make zoo-hygienic assessment of the level of lighting in different technological zones (stalls, manure and feed alleys) in semi-open freestall barns for dairy cows.

Material and methods

Study area

The survey was conducted over a period of one year (July 2014 - June 2015) in 3 production buildings (No.1, No.2, No.3) from 3 different cattle farms located in three different regions (districts) of South Bulgaria - Stara Zagora, Haskovo and Plovdiv. The areas of the three farms fall under transitional continental climate zone. In all farms, cows of Holstein breed were housed in semi-open freestal barns. The average milk yield of the cows was from 8000 to 9000 kg for 305-day lactation. Feeding strategy was with total mixed ration *ad libitum*. Drinking water for the animals was provided by troughs located in the buildings and yards for walk of the cows.

The parameters of the studded buildings were as follows:

Building No.1 (Farm 1): capacity 120 cows, 60.00/18.00/3.00m, 1080m^2, technological zones - two manure alleys (width 4m), one feed alley (width 4m), stalls (210/110cm) located in 3 rows. The building had semi-open longitudinal walls, equipped with curtain sidewall openings that lift automatically at speed of airflow over 4 m/s, in rain and snow, and when the air temperature drops below 2°C. Cows were milked twice at 7.00 and 19.00h in a milking parlor. The manure cleaning was with a delta scraper.

Building No.2 (Farm 2): capacity 120 cows, 66.00/18.00/3.00m, 1188m^2, technological zones - two manure alleys (width 3.8m), a feed alley (width 4.8m), stalls (185/125cm) located in 3 rows. The both semi-open longitudinal walls were equipped with polyethylene curtains, which were lowered manually in adverse weather conditions. Cows were milked three times at 5.00, 12.00 and 19.00h in a milking parlor. The manure cleaning was with a delta scraper.

Building No.3 (Farm 3): capacity 500 cows, 90.00/45.00/3.30m, 4050m^2, technological zones - five manure alleys (width 3.6m), two feed alleys (width 5m), stalls (188/114cm) located in 5 rows. The building had one semi-open longitudinal wall in front of the feed alley. During the winter period, in adverse weather polyethylene nets were put on this wall. Cows were milked three times at 5.00, 12.00 and 19.00h in a milking parlor. The manure cleaning was with a delta scraper.

Measurement of the barn's lighting

The monitoring of the lighting in the studied buildings was conducted twice a month at 10.00, 12.00, 14.00, 16.00 and 18.00h, in three different technological zones - above the stalls, manure and feed alleys, at a height of 1m from the floor (in the living area of the cows). For this purpose, two combined measuring instruments - Lutron EM-9300SD with a measuring range of 0 to 20000 lux (powered by power station LS-856) and PU 150 with a measuring range of 0 to 100000 lux were used. Artificial lighting in the studied buildings was switched on only early in the morning and late in the afternoon, with the on/off time depending on the season and the duration of the day. Usually artificial lighting was used during the end of the autumn in the winter and at the beginning of the spring.

Factor assessment of the barn's lighting

Assessment of the influence of the factors – 'building', 'season' and 'hour of reporting' on the level of the barns lighting was made based on the following model:

$$Y_{ijkl} = \mu + F_i + S_j + H_k + e_{ijkl},$$

Where:

Y_{ijkl} is the dependent variable (level of illumination);

μ - average for the model;

F_i - effect of the factor 'building';

S_j - effect of the factor 'season';

H_k - effect of the factor 'hour of reporting';

e_{ijkl} - effect of uncontrolled factors (the error).

Animal-hygienic assessment of the barn's lighting

This assessment was performed through comparison of the results obtained in the different technological zones in the buildings with other country standards or such recommended by other authors.

Statistics

For basic statistical data processing MS Excel was used, and to estimate the statistical parameters and the analysis of the variance, the corresponding STATISTICA modules of StatSoft (Copyright 1990-1995 Microsoft Corp.).

Results and discussion

The results obtained for the measured levels of lighting (average values per season, minimum and maximum) in the studied farms revealed considerable variations by buildings, technological zones and seasons (Table 1). The tendency for variation in the values of the indicator was different among the different barns. The level of lighting varied within the widest range in building No.2 (1-9810 lux), followed by building No.1 (1-9390 lux) and building No.3 (8-1063 lux). The highest average lighting values in all seasons were established above the stalls in barn No.2 - from 1037.7 to 2240.3 lux. In this building, the lowest values of lighting above the manure alley were measured as compared to other zones - from 483.3 to 997.4 lux. The zone above the manure alley remained in shadow compared to the other two zones - the stalls and the feed alley. In building No.3 the lowest level of lighting in the stall zone was reported - from 90.7 to 161.4 lux. For the different seasons, the level of lighting above the feed alley was the highest - from 180.4 to 416.8 lux. These were quite large differences in the level of lighting in the different service areas.

The lowest average seasonal lighting values in all building zones were reported for building No.3: compared to building No.1 the lighting values were lower from 7.35 to 9.87 times over stalls, from 3.22 to 5.62 times over manure alleys and from 4.70 to 8.00 times over feed alleys; compared to building No.2, respectively - from 10.5 to 13.8 times over the stalls, from 3.32 to 4.78 times over manure alleys and from 2.79 to 4.93 times over feed alleys. In the three buildings, the most intense was the light above the feed alleys, followed by stalls and manure alleys. The exception is building No.2, where during summer, autumn and spring the highest illumination was measured above stalls followed by feed and manure alleys.

Table 1. Average, minimum and maximum levels of lighting (lux) in the different technological zones by buildings and seasons

Building	n	Stalls		Manure alley		n	Feed alley	
		x±SE	min-max	x±SE	min-max		x±SE	min-max
Summer								
No 1	150	1466.8±104.6	102-9390	1148.9±44.4	100-3130	75	2714.9±214.6	400-9330
No 2	250	1939.0±124.8	32-9810	976.7±52.8	24-4600	125	1804.1±104.8	353-6280
No 3	250	148.6±4.2	60-520	204.3±7.2	45-578	125	366.1±11.7	191-743
Autumn								
No 1	120	821.3±86.7	1-4840	636.2±50.7	1-2680	60	1129.5±111.5	1-3100
No 2	200	1175.2±120.4	1-5800	483.3±40.8	1-3820	100	670.0±49.7	1-1860
No 3	150	111.9±5.5	8-283	145.6±8.6	10-453	75	240.5±17.6	21-549
Winter								
No 1	90	667.2±98.4	12-4910	412.2±24.9	17-988	45	1439.3±217.9	62-4910
No 2	150	1037.7±142.5	1-9380	531.0±47.6	1-2230	75	1227.9±180.0	152-4920
No 3	150	90.7±7.4	11-1063	127.9±6.5	29-363	75	180.4±7.9	62-317
Spring								
No 1	60	1504.4±164.9	553-6700	1084.3±40.6	580-2073	30	3177.4±322.9	1145-8060
No 2	100	2240.3±259.8	124-9560	997.4±72.7	144-3550	50	1727.9±180.0	152-4920
No 3	100	161.4±4.9	76-295	208.6±10.9	73-525	50	416.8±24.2	111-1001

The levels of lighting in the three technological zones in building No.1 showed a one-way trend of change - during all seasons, higher average levels were measured above the feed alley compared to the other two zones. The same applies to building No.3. For building No.2, the highest average values were recorded above the stall zone, with exception of the winter, when the highest lighting was above the feed alley. In building No.1 during all seasons the illumination was the highest above the feed alley. The same applies to building No.3.

In building No.2, the highest average values were reported above the stall zone, except for the winter season, when they were reported above the feed alley. In this connection, Buyserie et al. (2001) found that the light should be distributed evenly throughout the barn, without "lighted spots" and "dark areas". Harner (2008) recommended for the different zones in the building an appropriate lighting to be provided - in the zone above the stalls and the feed alley 200 lux, with a variation of 25 to 45% in order to avoid shadows and dark spots. Chastian (1996) allowed a deviation from the illumination standards ± 25% or less.

Buyserie et al. (2001) consider that milk production can be increased by managing the duration of exposure of dairy cows to light. The exposure to light was defined as duration of light exposure within a 24-hour period. Long-term photoperiod (LTPP) means exposure for 16-18 hours of continuous light followed by 6-8 hours of darkness. One short-term photoperiod (STPP) was defined as a duration of exposure to light for 8 hours, followed by a continuous 16-hour period of darkness. In practice, STPP is any period with less than 12-13 hours of light. Lactating cows permanently exposed to LTPP show 8-10% increase in the daily milk yield (an average of 2.5kg of milk/cow/day) regardless of their initial level of milk yield.

The constant exposure to light does not produce a positive response (Marcek and Swandson, 1984). The presence of light influences the retina of the cows, inhibiting the enzyme used in the synthesis of melatonin in the pineal gland. Thus, with a longer photoperiod, the duration of periods with high blood melatonin levels is less. Blood melatonin concentration has a negative effect on the blood levels of other hormones such as prolactin, a hormone considered to play a positive role as a factor in milk production (Buyserie et al., 2001). Cook (2011) recommends for the "bright" period of the day, the light intensity to be at least 160 lux at 1m above the floor. During the “dark” period - no more than 54 lux is needed.

For the climatic zone of the regions of the studied farms, the duration of the natural daylight varies depending on the season: summer and autumn from 12 to 15 hours; winter and spring from 9 to 12 hours (IANAO-BAN, 2018). Similar figures for Spain are also indicated by González-Barragán and Calzada (2014) - the maximum duration of the day reaches 15.5 hours in the summer and the shorter days in winter reach 9.5 hours. This showed that under natural conditions, the longest day of the year might have natural light corresponding to a long-term photoperiod, whereas in the shortest days of the year we have conditions closer to a short-term photoperiod. Animals use daytime light as an indicator of what time of year it is because the longer day corresponds to the beginning of spring, which is usually associated with an increase in temperature.

The analysis of the variance (Table 2) showed that all fixed factors (building, season and hour of reporting) had a significant effect on the level of lighting over the three service zones in the buildings surveyed.

Table 2. Analysis of variance for the influence of the controlled factors on the level of lighting in the zones above the stalls, manure and feed alleys in the studied buildings

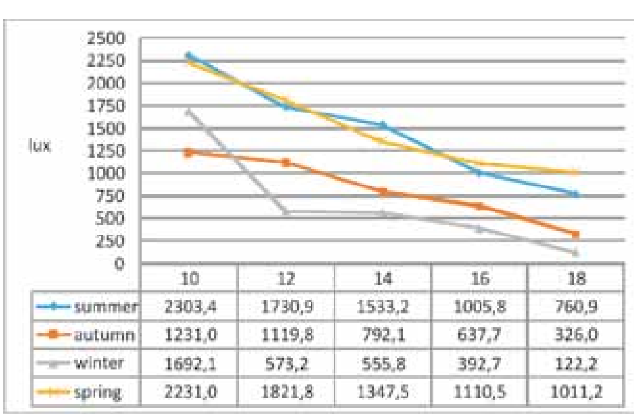
Sources of variation	Degrees of freedom	Above the stalls		Above the manure alley		Above the feed alley	
	(n - 1)	MS	F	MS	F	MS	F
General for the model	59	21928415	13.2***	4805635	21.1***	14741129	19.6***
Building	2	3.335	201.4***	67684892	296.7***	1.955	262.0***
Season	3	4.572	27.6***	20492487	89.8***	5.921	79.4 ***
Hour of reporting	4	2.933	14.1***	3734076	16.4***	2.773	3.2**
Building*Season	6	1.184	7.15***	4098932	17.9 ***	1.214	16.3 ***
Building*Hour of reporting	8	1.971	11.9***	1072164	4.7***	1.133	15.2***
Season*Hour of reporting	12	2.120	1.3 ns	322732	1.4 ns	5.761	7.7***
Building*Season*Hour of reporting	24	3.746	2.3 ***	818016	3.6***	4.594	6.6***
Error	1710	1.656		228116		7.452	

Significant at: *P <0.05; **P <0.01; ***P <0.001; ns - no significant effect

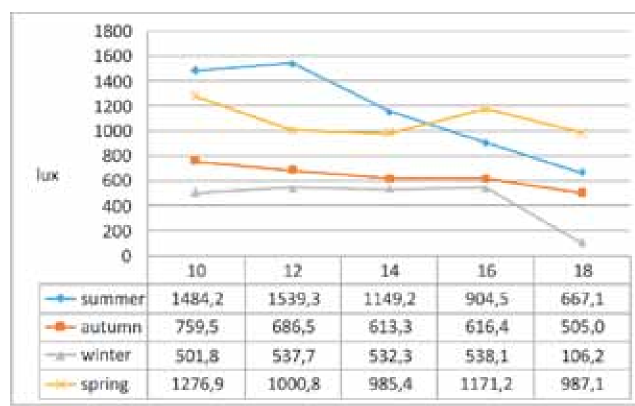
Of the associated factors, only the combination ‘season*hour of reporting’ had no significant effect (P>0.05) in the stall zone and above the manure alley. The level of lighting in these zones had similar variation in all seasons by farms.

Figure 1, for the variation in lighting in the three zones of building No.1, showed a relation associated to the orientation of exposure of the building. The level of illumination for all seasons was the highest in the morning in the zone of the stalls, followed by the zone above the manure alley.

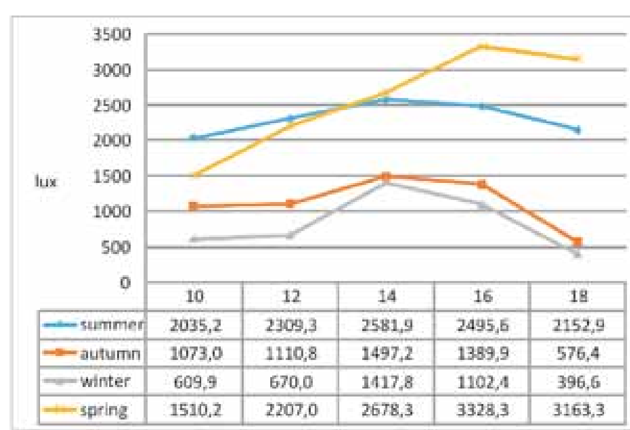
In the zone above the feed alley, the level of lighting follows a reverse relationship - it increases gradually to its maximum at 16.00h, then decreases. This was due to the orientation of the building Southeast - Northwest. The stall zone was exposed to sunshine in the morning, and in the afternoon, it was in the shade, at the zone above feed alley, it was the



a) Lighting above the stall zone in building No.1



b) Lighting above the manure alley in building No.1



c) Lighting above the feed alley in building No.1

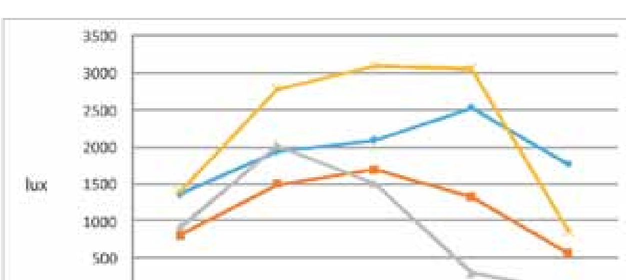
Figure 1. Lighting by seasons and hours of the day in the different technological zones (a, b, c) of building No.1

opposite. Despite the variation in the degree of lighting by seasons as well as by hour of reporting, at daylight the level of illumination was above 160 lux, with the exception of the winter season in two zones - above the stalls and the manure alley where the illumination dropped to an average of 122.2 and 106.2 lux. This means that during summer, autumn and spring there were prerequisites due to the natural lighting in this type of building, at least 16 hours of daylight (photoperiod) to be provided. In the winter months up to 8am and after 6pm the artificial lighting was with low intensity and could not provide the recommended above 160 lux.

Orientation of building No.1 East-West along the longitudinal axis allowed good lighting, without being related to a strong solar heating in the stall zone in the middle of the day, which is a prerequisite for high surface temperatures of the stall floor.

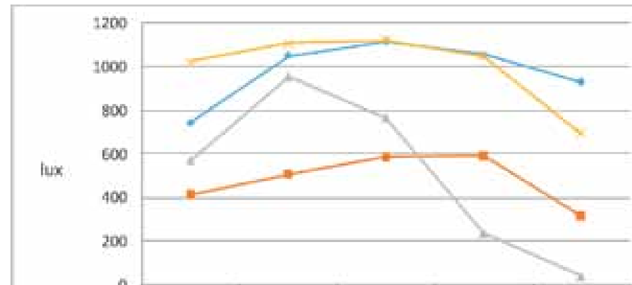
In building No.2 (Figure 2), which is the same as building No.1, but with different orientation exposure – South-North, the variation in the level of daylight had another pattern. In the zone above the stalls and the manure alley, the level of lighting was the highest in the middle of the day - from 12.00 to 16.00h. In the morning and afternoon hours the degree of lighting decreases, while in the winter months early in the morning and in the afternoon about 18 o'clock the lighting over the stalls and the manure alley decreased strongly - 45.5 and 36.4 lux. In the morning and afternoon hours, the degree was decreased and in the winter months early in the morning and in the afternoon at about 18.00h the lighting over the stalls and the manure alley was strongly decreased - 45.5 and 36.4 lux. Similar was the trend of variation above the feed alley, but with less variation by hour of reporting.

In bright, sunny days, the cows on farms with open sidewalls and these on pasture avoid bright light, probably mostly to avoid heat associated with sunlight. When building new barns, the author recommends the front edges of the buildings to be oriented northwest and southeast, partly to capture the prevailing southwest wind from the open side on hot days, but also to minimize the penetration of the afternoon sun (Site DairyLogix). In our previous study it was found that in the south-north orientation of the building, the floor of the stalls is also exposed to strong sunlight during the warmest hours of the day and a high surface temperature of the stall



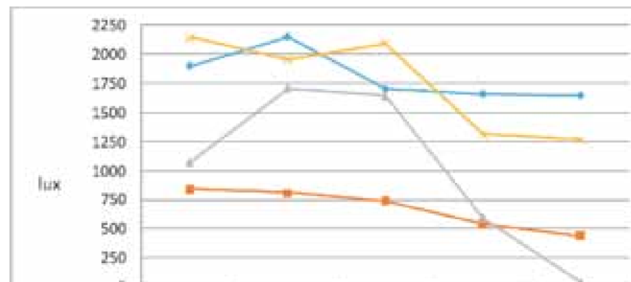
	10	12	14	16	18
summer	1366,0	1937,3	2092,7	2529,7	1769,4
autumn	803,3	1494,6	1692,9	1325,3	559,9
winter	921,7	2019,1	1505,0	299,4	43,5
spring	1404,7	2786,5	3089,4	3060,8	850,2

a) Lighting above the stall zone in building No.2



	10	12	14	16	18
summer	743,4	1049,1	1112,9	1052,3	925,6
autumn	414,9	507,9	586,9	592,1	314,7
winter	567,3	952,4	764,4	236,5	36,4
spring	1023,2	1102,9	1118,5	1048,4	694,3

b) Lighting above the manure alley in building No2



	10	12	14	16	18
summer	1890,2	2142,3	1698,0	1648,8	1641,3
autumn	838,3	802,0	731,0	543,0	436,9
winter	1062,9	1706,9	1630,7	591,0	37,1
spring	2135,2	1952,7	2084,0	1306,3	1261,7

c) Lighting above the feed alley in building No.2

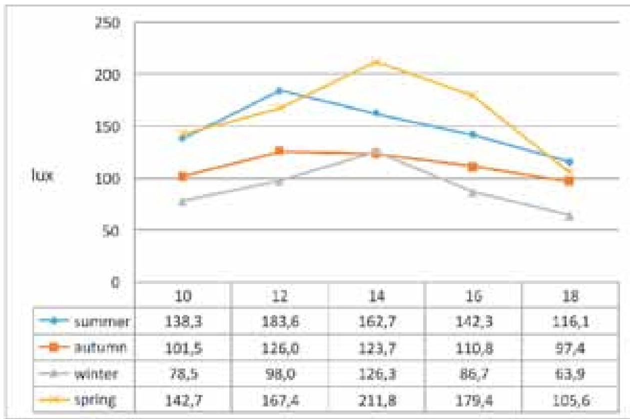
Figure 2. Lighting by seasons and hours in the different technological zones (a, b, c) of building No.2

floor. This leads to reluctance of the cows to use stalls for rest (Dimov et al., 2017).

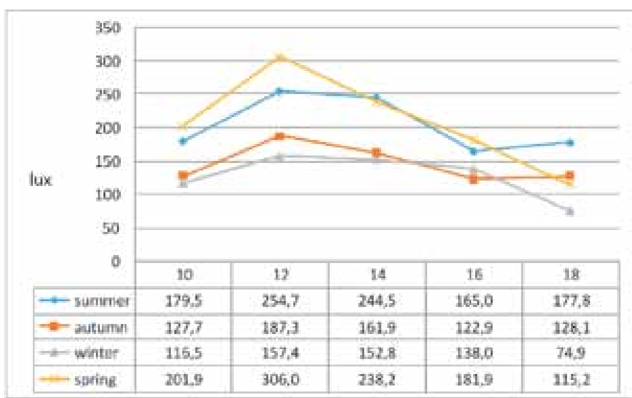
Compared to buildings No.1 and No.2, in No.3 (Figure 3), the lowest lighting level during the day for all zones and seasons was reported. There was a tendency for better lighting at noon hours 12-14.00h in the three service zones. During most of the day for all seasons, the level of lighting above the stalls and the manure alley where the animals stay the longest, was low and below 160 lux. In the winter months, the level of lighting in these zones was below the recommended for the photoperiod throughout the day. The highest was the lighting in the zone of the feed alley, which was located on the outer open wall of the building.

Buyserie et al. (2001) noted that a common mistake was to place lights just over the feeding area and unevenly throughout the rest space of the building. A cow is usually in the feed alley 3-4 hours a day and rests in the stalls 9-14 hours a day. If illumination is inadequate in the stall zone where the cow spends most of its time, it will not be exposed to the required photoperiod.

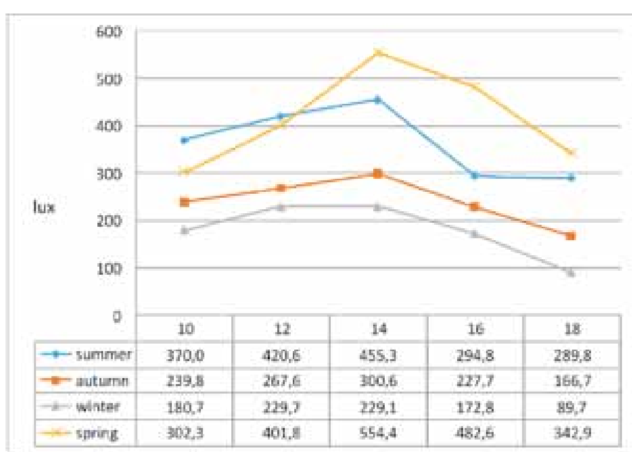
In poor lighting outside the night hours, as Josefsson (2000) points out, trivial staff incidents (slipping and falling) occur during work in the barn. These injuries may sometimes



a) Lighting above the stall zone in building No.3



b) Lighting above the manure alley in building No.3



c) Lighting above the feed alley in building No.3

Figure 3. Lighting by seasons and hours in the different technological zones (a, b, c) of building No.3

be fatal. Good lighting helps workers detect obstacles and slippery areas. Better lighting also facilitates spotting cows with health problems, cows that do not eat, scattered or contaminated feed, and so on. In addition, most people feel better at an illuminated workplace and can therefore become more efficient. This also applies to farm staff. Cook (2011) points that improving the lighting in buildings for lactating cows is a simple task, but it requires a certain level of investment, the payback period is relatively short and additional costs can be offset by using the increased energy efficiency of new systems for lighting. Due to improved lighting and extended light part of the day, increases in milk yield and reproductive performance are also reported, as well as facilitating the work of the staff. It should be emphasized that this is not a solution to all production problems but will help to improve production as part of the overall approach to farming, respectively, if the feeding, comfort, building design and other environmental factors are also adequate.

It has been found that investing in luminaries and timers in building can be recovered in less than a year as a result of increased milk yield of lactating cows. An optimal lighting plan can also be made to provide the recommended 160 to 200 lux for 16 - 18 hours of the day (Site DairyLogix).

The studied semi-open free stall barns for dairy cows with a smaller width - 18.00m (No.1 and No.2), provided better lighting in all service zones during the day, compared to a semi-open building with larger width - 45.00m (No.3). The better option of orientation of the buildings of this type was Southeast-Northwest, thereby avoiding strong sunlight, leading to an excessive increase in the temperature of the floor, especially during noon hours.

Conclusion

The results obtained in the present study revealed that the level of lighting in the buildings for dairy cows with different capacity, dimensions and built-up area was unevenly distributed and varies in wide ranges (1-9810 lux) by buildings, technological zones, seasons and hours during the day. In all barns the most intense was the light above the feed alleys, followed by stalls and manure alleys; by hours of reporting during the day the level of lighting above the three technological zones was higher at midday (12.00-14.00h) compared to morning (10.00h) and afternoon (18.00h). Buildings with a smaller built-up area (No.1-1080m^2 and No.2-1188m^2) provide more intensive lighting over all technological zones throughout all seasons compared to building No.3 with bigger built-up area (4050m^2): from 7.34 to 13.8 times over the stalls, from 3.22 to 5.62 times over the manure alleys and from 2.79 to 8.00 times over the feed alleys. In buildings No.1 and No.2, during summer, autumn and spring a daylight day of at least 16 hours of day light (photoperiod) is provided, while in the winter months up to 8.00am and after 6.00pm the used artificial lighting was with low intensity and could not provide the recommended over 160 lux intensity of the light. In building No.3 during most of the day for all seasons, the level of lighting above the stalls and manure alley where the animals stay the longest, the lighting level was lower than 160 lux. All fixed factors (farm, season and hour of reporting) had statistically significant effect ($P<0.05-0.001$) on the level of lighting over the three technological zones of the buildings surveyed. Of the associated factors, only the combination 'season*hour of reporting' had no proven effect on the lighting in the stall's zone and the manure alley. In the national legislation (Regulation No. 44/2006 for animal health requirements for livestock holdings), there are no regulated lighting norms (both for the day and for the dark part of the day), in production buildings for dairy cows, which is a serious omission in the animal hygiene regulation of environmental parameters in buildings for cattle, and in our opinion requires their development and justification. The results obtained are a serious prerequisite for continuing the research in this area.

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