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MICROCLIMATE PARAMETERS AND THERMIC BALANCE OF COMMON TYPE STABLE IN POLAND ADAPTED FROM OLD COWSHED

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Introduction

Investigations on the stable microclimate can be very useful for establishing the best conditions of stable environment, protecting the welfare of horses and maximizing their working ability. Such investigations can be helpful for government in preparing the legislation acts about animal farm welfare and for people planning horse facilities and preparing plans of stables and ventilation systems.

Thermic balance of buildings for farm animals was studied from many years by scientists and practitioners, but there were still a lack of instruments for estimation the quality of buildings with regard for this parameter. Wolski (1988) transformed the formula for calculation of thermic balance (WWT) into the form of percentage value, enabling the preliminary estimation of thermic balance of buildings for farm animals. After comparing the results of microclimate measurements in buildings for farm animals with WWT parameters, Bombik i Kolbuszewski (1991) proposed the scale for estimation of buildings with regard for this parameter. This enables precise evaluation of buildings. Good building should have the optimal microclimate parameters, sufficient - minimal and insufficient have below minimal microclimate parameters and should be modified.

The aim of the study was to evaluate living conditions for horses from Warsaw Agricultural University (SGGW) stable by analysing some microclimatic and thermic balance data registered in the winter and comparing them with the polish recommendations and legislation.

Material and methods

Investigations were carried out in the old stable of the riding center of Warsaw Agricultural University (SGGW) with 23 individual loose boxes made of wood and grids, with area varied between 11.0 and 15.5 m². The analysed building was constructed of concrete and bricks in the beginning of the XX century as a cowshed and was adapted to

horses in the 1970`s. It was oriented east-west and belongs to the common type of buildings with three doors and hay and straw storage on the second floor. The part of stable where horses were kept was 57 m long, 10 m wide and 3 m high. The ventilation was natural, making use of the stack effect. It had the windows of awning type with the size of 0.55 m^2 each and doors as inlets and four chimneys in the center of the ceiling as outlets. In the time of the study the stable offered shelter for 23 horses of several breeds including Arabians, Thoroughbreds, Wielkopolska, Malopolska, Polish Warmblood, Huzul and ponies. The mean body weight of horses was about 450 kg. Straw was used as a bedding.

Data collection consisted of registering temperature, relative humidity, air velocity, CO_2, NH_3, inside and outside of the building in winter (24.01– 11.03.2005). The measurements were taken in 3 places in a stable on the methodological basis of Polish Standard BN-86/8800-03 „Microclimate in buildings for farm animals – Methodology of measurements" (Norma Branzowa, 1986).

Thermic balance of stable was calculated by means of the equation (Wolski, 1988):

$$WWT = \frac{Q_{zw} \times 100}{Q_b + Q_w}$$

where:

WWT – thermic balance of the building

Q_{zw} – emission of the heat by animals
Q_b – heat losses by stable walls
Q_w – heat losses by ventilation

To estimate the quality of the stable with regard of thermic balance, the results of microclimate measurements in the stable were compared with the WWT scale for estimation of buildings for farm animals proposed by Bombik and Kolbuszewski (1991) and with the polish standards and recommendations regulating environmental parameters in the stables (Rozporzadzenie Ministra Rolnictwa i Rozwoju Wsi z dnia 2 wrzesnia 2003 r. Dz. U. z roku 2003 nr 167, poz. 1629). In the case of minimal values of microclimate parameters, WWT ranged from 70 to 80%, and with optimal values of microclimate parameters – from 85 to 100%.

Results and discussion

All the data collected during the winter period and theirs relation to the Polish low and recommendations regulating environmental parameters in the stables can be seen in table 1.

Tab. 1 Microclimate parameters of the stable in the winter compared with Polish norms and recommendations.

Microclimate parameters	minimum	mean	maximum	Polish standards of microclimate parameters
Internal temperature [°C]	3,4	4,6	5,7	5 - 28
Internal humidity [%]	57,3	67,8	76,5	max. 80
Air velocity [m/s]	0,15	0,25	0,35	0.30
Concetrations of toxic gases: - CO_2 [vol. %] - NH_3 [mg/m^3]	 0,1 0	 0,15 1,5	 0,25 3	 0.3 20
Natural light [lx] Artificial light [lx] Proportion windows : floor area	3,28 15,16 1 : 47			15 – 30* 1:15**

* - recommendations - (Kosla 2001)
** - recommendations - (Fiedorowicz et all. 2004)

Some microclimate parameters were close to the minimal level of standards or recommendations. It seems, that Polish standards for temperature for horses are too high. According to Marcenac and Aublet (1980), internal temperature should ranged from 5°C to 15-20°C. Wright, (2000) suggest that an adult horse acclimatised to mild Canadian winter temperatures has an estimated in outdoors thermoneutral zone between 15ºC and 10ºC.

Regarding the internal humidity one can see that this parameter was mainly dependent of external humidity. In this way it could be very difficult to expel the internal humidity by ventilation when the outside humidity was very high.

The air velocity was expected to be independent from the other parameters. This treat was only dependent on the outside wind velocity and the rate of internal ventilation.

There were 22 windows in the stable to provide natural light and ventilation to the horses. The area covered by windows (total of 12,17 m^2) was approximately 1/47 of the total floor area (570 m^2). If one considers the extra natural light that could be offered by the two main doors (2,0 x 2,0 = 4,0 m^2 and 2,40 x 2,10= 5,04 m^2), an extra of 9,04 m^2 of natural light

could be added. In this way the area allowing sunlight inside was 1/27 of the floor surface. This value is still too far from the recommendations (1 : 15 for sport horses, 1 : 12 for breeding horses) which is natural feature for old cowshed built with small windows. Even with almost one window per box and with the two main doors open, there is not enough natural light in the stable. That problem could be solved by installing skylights (approximately 10% of the roof area) but because of the second floor it is not possible in that type of stable. This lack of artificial light can be solved easily after installing more lamps.

Results of analysis of collected data shows, that in the winter they were on the minimal level of standards. WWT ranging from 82–85% assure minimal microclimate parameters for horses and represent sufficient quality of building and acceptable living conditions for horses.

Conclusions

1. The relation between microclimate parameters and WWT results was discovered.
2. WWT is useful for evaluating living conditions and expecting the range of microclimate parameters in buildings for horses, so could be helpful for establishing the optimal conditions of stable environment, protecting the welfare of horses and maximizing their working ability.

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