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COMPARISON OF THE WELFARE OF FELIN PONIES KEPT IN SELECTED STABLES DURING WINTER SEASON

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Abstract

The aim of the study was to compare the housing conditions of Felin ponies in two centres during winter season. Centre A consisted of one, newly built, unfinished, closed building. In centre B, the horses were kept in four rooms located in two buildings adapted from old sheepfolds. In both centres, the standards of box area for individually kept horses were met, however for mares with foals and young horses kept in pairs were not. In all stables, the average indoor temperature, relative humidity, air velocity, carbon dioxide concentration and light intensity were in line with the horse welfare requirements, in contrast to the natural light index, which was very low except in one stable. The area and volume indicators in the studied stables were generally correct. In terms of building development, box area as well as area and volume indicators, the stables in centre A to a greater extent met the welfare standards associated with maintaining horses compared to the adapted rooms in centre B, where the microclimate was better. The primary purpose of the buildings may have an impact on the quality of the horses' maintenance conditions. Not only when adapting old buildings, but also when building new stables, the standards regarding the area, volume, lighting and microclimate should be strictly observed. In order to maintain the proper level of welfare, not only the financial capabilities of the investor or the owner of the former stable are important, but most of all the knowledge that allows reaching a compromise between satisfying the needs of a horse and the possibilities of a human.

Key words: Felin ponies, stable, welfare

Introduction

In recent years, a growing interest in the breeding and use of horses in Poland has been observed. The number of centres in which new stables are under construction or old farm buildings are converted for other uses has been increasing rapidly. A stable is a place where horses spend a considerable part of the day, especially those used for sports or recreational purposes. It is therefore important to provide them with optimal living conditions commonly referred to as welfare (Hughes & Duncan, 1988), which ensure both freedom from hunger, thirst, and malnutrition, physical and thermal discomfort, pain, injury and illness, fear and stress and the possibility of manifesting normal behaviours (Mellor, 2016). The rooms in which horses are housed should take into account the needs resulting from their ethology and also facilitate the handling of animals by humans to the greatest extent possible. Conditions in buildings that fail to meet the animal welfare condition standards have an adverse effect on the fitness and condition of the animals and can also lead to a decrease in immunity and the occurrence of, e.g. respiratory diseases (Max, 2003: Herbut & Walczak, 2004).

The breed of a horse and the way it is used, or the location of the centre are of importance when selecting an appropriate housing system, either an individual or group system, which is often modified depending on the available buildings, the financial possibilities, and the intended purpose of the centre (Pirkelmann et al., 2010). Individual horse housing systems, including stalls and boxes, often prevent horses from manifesting their normal behaviours resulting from the need for movement or social contacts. They are, however, much more convenient for the owners and service staff, as they ensure easy access to animals and control of their health. Nowadays, when efforts are being made to improve horses' welfare, such systems are not recommended (Cooper, 2000; Bombik et al., 2009b).

Group systems are definitely a better way to keep horses because of the greater possibility for movement and social contacts. They allow the horses to manifest their normal behaviours, which is particularly important for young individuals whose character and mental traits are just being formed. Groups of horses kept in traditional or sector run pens differ in the composition and numbers from those found in the wild, where they are usually formed by family members. The arrangement of the space involving the separation of various sectors intended, e.g. for feeding, watering, resting, or playing, forces the horses to move constantly to satisfy their needs, which is intended to simulate the life of horses under natural conditions. This housing system is suitable for all horses irrespective of their age, breed or the way they are used. However, it must be understood that this system hinders access to animals and reduces the possibility of their individual control (Pirkelmann et al., 2010; Łuszczyński et al., 2017). The requirements imposed on stable buildings should also take into account their microclimate, which has a large impact on the condition and health of the horses and thus can affect the level of their welfare. The most important microclimate parameters in the stable include the temperature, humidity and air movement and the concentration of noxious gases (Herbut & Walczak, 2004; Jezierski & Górecka, 2007).

Felin ponies are small Polish horses of the riding pony type. The breeding concept for this breed population was developed in the early 1970s by a team of employees of the Academy of Agriculture in Lublin under the leadership of Professor dr hab. Ewald Sasimowski. In the beginning, the Koniks (Polish primitive horses), Hucul horses and Shetland ponies were used for cross-breeding. Later on, in order to accentuate certain desirable features, horses of such breeds as the Welsh pony, the Malopolski horse and purebred Arabians were used in cross-breeding. The Felin ponies were developed in response to the need for a small, versatile pony suitable for riding that could be used for teaching children and youth how to ride (Kamieniak & Sołtys, 2013). As there is a high proportion of primitive horse blood in the pedigree of Felin ponies, they are perfectly adapted to adverse environmental conditions, resistant to diseases and not demanding in terms of maintenance and nutrition. Nevertheless, in view of Polish climate and natural conditions, rooms, as with other breeds, are the "necessary evil" for Felin ponies. The use of rooms primarily results from the need to ensure better organisation of work when using these horses for recreational purposes. Therefore, if Felin ponies must be housed in stable buildings, these should be designed in such a manner that the conditions they offer are designed to prevent the horses from changing their natural behaviours developed through evolution (Łuszczyński et al., 2017).

The aim of the study was to compare the housing conditions for Felin ponies at two centres during the winter period, with a simultaneous assessment of the level of their welfare, conducted in accordance with the existing standards for the accommodation for horses.

Material and methods

The study was conducted in two facilities situated in Dolnośląskie Voivodeship (Centre A) and Lubelskie Voivodeship (Centre B). At both centres, the animals were kept under the stable and pasture system and used for recreational and breeding purposes. In the buildings, horses were kept on straw bedding, either individually in boxes (Centre A) or in boxes, both in pairs and individually, and in tie stalls (Centre B).

At Centre A, 17 horses were kept: seven Felin pony breed mares and ten other horses of noble breeds. However, at Centre B, 20 horses of the Felin pony breed were kept: one stallion, two geldings, and six breeding mares – adult horses, and two colts, two geldings, and seven mares – suckling foals and the young stock. The assessment of horse housing conditions was conducted in January based on the animal welfare condition inventory survey and the measurements of the stable microclimate conducted by the direct measurement method. The animal welfare condition survey involved, e.g. the measurements of buildings and the facilities they provide (boxes, tie stalls, corridors, etc.), the number and size of windows and the number and power rating of electric bulbs. Plans of the buildings were drawn up and the indicators were calculated according to the equations developed on the basis of the formulas provided by Bombik et al. (2009a, 2011):

$$\text{surface index} = \frac{\text{usable floor area } [\text{m}^2]}{\text{number of horses}}$$

$$\text{cubic volume index} = \frac{\text{cubic volume of the facility } [\text{m}^3]}{\text{number of horses}}$$

$$\text{natural lighting index} = \frac{\text{glazed window area } [\text{m}^2]}{\text{usable floor area } [\text{m}^2]}$$

$$\text{artificial lighting index} = \frac{\text{bulb power rating } [\text{W}]}{\text{usable floor area } [\text{m}^2]}$$

The microclimate measurements using an ExTech AN320 anemometer included the air temperature, the relative humidity, air movement velocity, carbon dioxide concentration in the stable and the external temperature. The illumination intensity in the stable was determined using an ExTech 407026 lux meter. The measurements were taken three times a day (at approx. 08.00 AM, 12.00 AM, and 04.00 PM), at the withers height, in six replications, with each replication in the stable being carried out at two measuring points, i.e. in the feed corridor and in a boxes or tie stall.

The obtained measurement results were processed statistically using Statistica 13.0 software. The feature distribution normality was verified using the Kolmogorov-Smirnov test, at $\alpha = 0.05$. One-way analysis of variance was carried out, and the significance of differences between the average values at Centre B was determined using Tukey's test.

Results

Centre A comprised one newly-constructed, closed-in shell building. Its space was arranged in a manner typical of stables, with boxes located along the long walls, with the transport route (feed and manure corridor) running between them down the middle of the building (Fig. 1). The stable comprised 19 boxes, 17 of which were used for housing horses and the remaining two for hay storage. Next to each box, there were two windows situated one above the other (Fig. 2). The building had no usable attic.

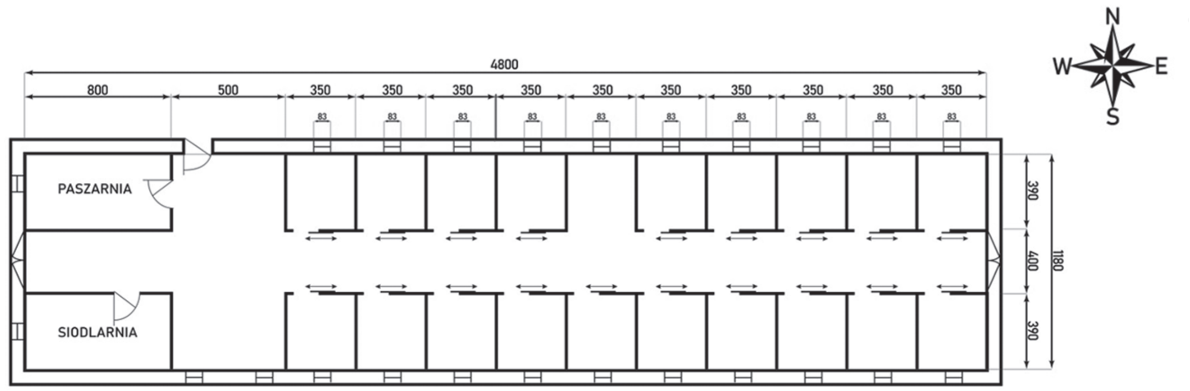

Fig. 1. The floor plan of the stable in centre A

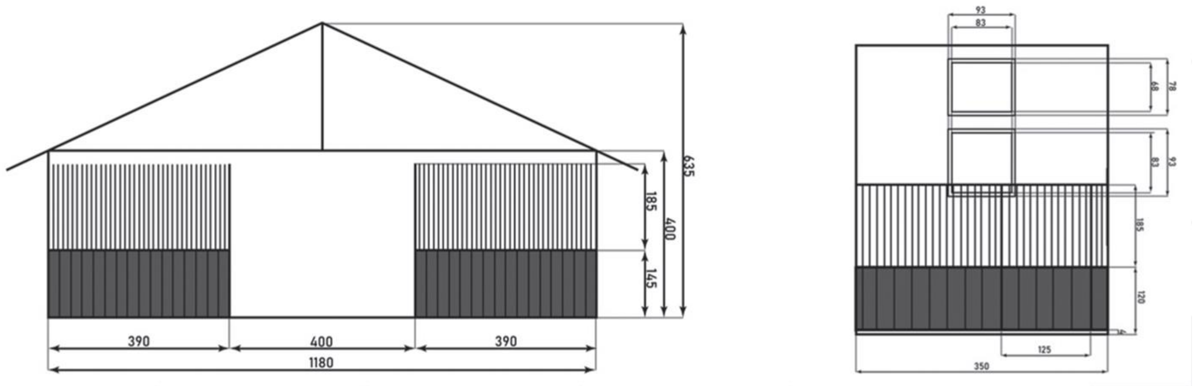

Fig. 2. Cross section and diagram of the box (view from the corridor) of the stables in centre A

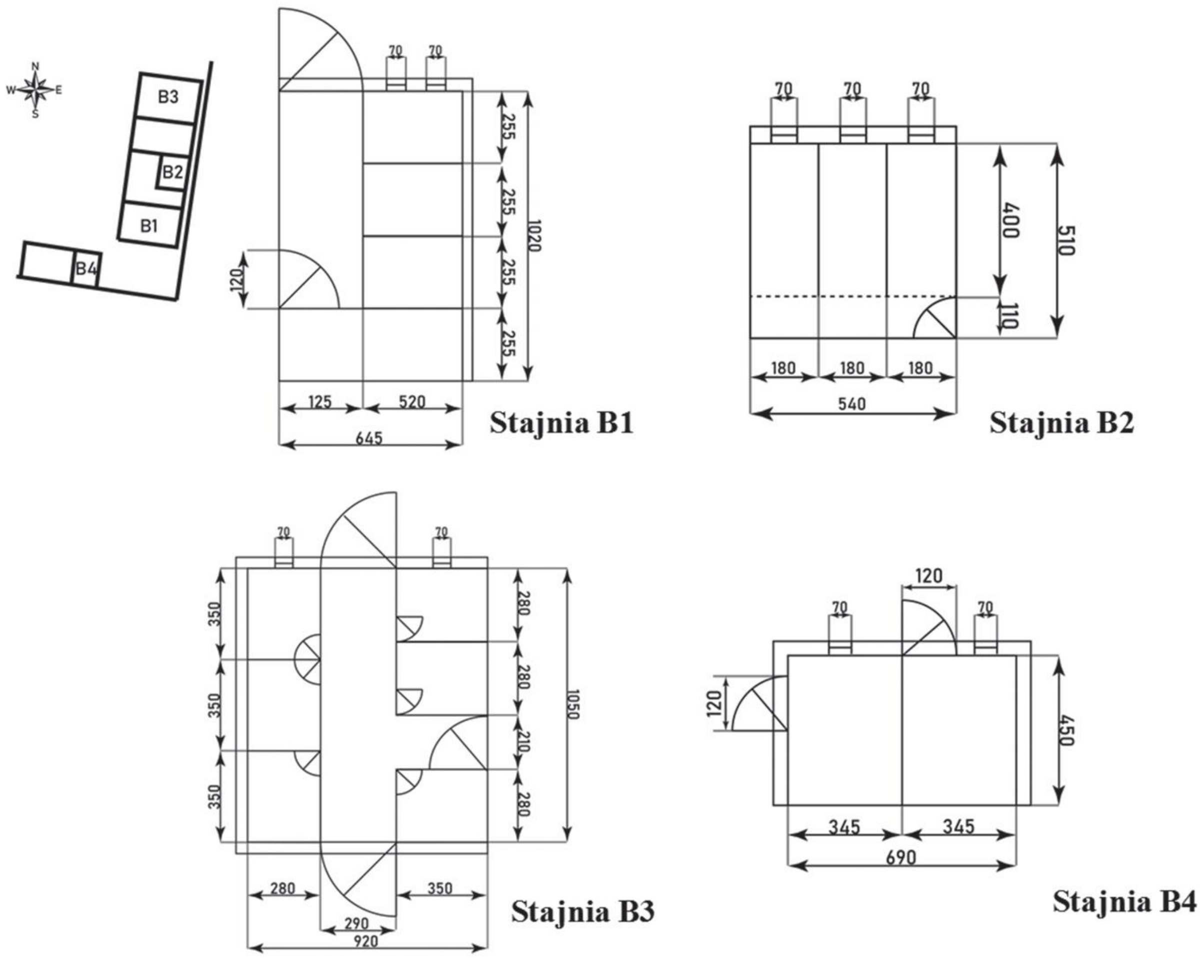

Fig. 3. Layout and floor plans of the stables in centre B

At Centre B, the horses were housed in four rooms (marked B1, B2, B3, and B4, respectively) in two buildings. These buildings had been converted from former sheep sheds. In three rooms (B1, B3, and B4), there were boxes, while in one building (B2), there were tie stalls (Fig. 3). Both buildings at the centre had a usable attic. Adult animals were kept individually (B1 - three mares, B2 - three geldings, B3 - one mare), mares with suckling foals (B3 - two mares with suckling foals), and the young stock were kept in pairs (B3 - six head in three boxes). Stable B4 housed three stallions - a sire kept individually in one box and two young stallions in another.

Table 1. Conditions for maintaining horses in the studied stables

Parameter	Centre A	Centre B			
	stable A	stable B1	stable B2	stable B3	stable B4
Number of maintained horses	17	3	3	11	3
Box dimensions length/width (m)	3,5/3,9	3,5/2,5		2,8/3,5	3,5/4,5
Stall dimensions length/width (m)			4,0/1,8		
Surface area of box (m^2)	13,65	8,75		9,80	15,75
Surface index (m^2/animal)	30,74	21,93	9,20	8,99	10,35
Cubic volume index (m^3/animal)	184,41	57,03	23,91	23,37	26,91

Table 2. Parameters of natural and artificial lighting in the studied stables

Parameetr	Centre A	Centre B			
	stable A	stable B1	stable B2	stable B3	stable B4
Number of windows	40	2	3	2	2
Window dimensions length/width (m)	0,8/0,8	1,1/0,7	1,1/0,7	1,1/0,7	1,1/0,7
Natural light indicator (W:F)	1:21	1:43	1:12	1:64	1:20
Artificial light indicator [W/m^2]	1,52	3,65	8,70	3,68	12,24
Light intensity (lx)	30	16	28	19	20

Table 3. Microclimate parameters in the studied stables during winter season

Parameter	Centre A			Centre B											
	Stable A			Stable B1			Stable B2			Stable B3			Stable B4		
	x̄±SD	min	max	x̄±SD	min	max	x̄±SD	min	max	x̄±SD	min	max	x̄±SD	min	max
Indoor temperature (°C)	4,7±0,7	3,8	5,9	13,4±0,4 A	12,7	14,1	8,9±0,3 B	8,4	9,4	7,2±0,3 C	6,7	7,9	2,1±0,3 D	1,5	2,7
Outdoor temperatur (°C)	4,9±1,2 A	3,0	6,9	-5,3±0,8 B	-6,5	-4,2	-5,3±0,8 B	-6,5	-4,2	-5,3±0,8 B	-6,5	-4,2	-5,3±0,8 B	-6,5	-4,2
Difference between indoor and the outdoor temp. (°C]	0,6±0,4 A	0,0	1,3	18,7±1,0 B	17,7	20,6	14,3±0,8 C	13,2	15,8	12,5±0,9 D	11,2	14,0	7,5±1,0 E	5,8	9,2
Relative humidity (%)	78,1±6,3	67,0	88,0	30,4±5,1 A	20,0	37,0	37,9±5,3 B	31,0	48,0	53,9±3,6 C	48,0	60,0	61,5±4,3 D	57,0	75,0
Air speed [m/s]	0,00±0,0	0,0	0,0	0,32±0,1 ABa	0,2	0,5	0,30±0,1 A	0,2	0,5	0,22±0,1 Bb	0,0	0,3	0,17±0,1 C	0,0	0,3
Carbon dioxide [ppm]	232±57	139	312	272±82 A	143	356	559±75 B	415	641	1243±149 C	989	1464	714±88 D	579	834

Within rows means marked by different letters differed significantly at: a, b - P≤0.05; A, B, C, D - P≤0.01

Table 1 provides the results of the animal welfare condition inventory survey concerning the horse keeping conditions. It was demonstrated that the dimensions or the area of rooms for animals kept individually (tie stalls in stable B2, boxes in stables A, B1, B3, and B4) were compliant with the existing standards, contrary to those in which horses were kept in pairs (boxes in stables B3 and B4). Both the surface and cubic volume index values were greater in stable A than in the rooms at Centre B. Except for stables B2 and B3, in which the cubic volume index value was slightly lower than the lower range of the standard provided by Kośla (2011), the requirements for the discussed indices in other rooms were maintained. The window surface to the floor surface ratio in the stables under study, with the exception of room B2, did not provide the horses housed in them with adequate conditions as regards natural lighting (Table 2). Although the artificial (incandescent) lighting intensity fell in the standard range from 8 to 16 W/m2 only for stables B1 and B3 (Kośla, 2011), the lighting intensity in the stables in both centres was, despite great variations, was in compliance with the established requirements.

A number of differences were demonstrated in the microclimatic index values between the examined stables during the winter period. At Centre B, in many cases, these differences proved to be significant or highly significant (Table 3). The average internal temperature differed highly significantly between all rooms, with the highest temperature noted in stable B, and the lowest temperature in stable B4. The average relative humidity differed between stables at various centres, and also highly significantly between the rooms at Centre B. The greatest average air movement was noted in room B2, and differed highly significantly as compared to rooms B3 and B4. In stable B1, a similar air flow rate was observed, which appeared to be significantly higher than that in room B3, and significantly higher compared to stable B4, for which this index was the lowest. The average value of the carbon dioxide concentration in the stable at Centre A was lower than that in the rooms at Centre B, in which the differences in the level of this gas appeared to be highly significant.

Analysis of results

In terms of space development, the centres differed from each other. However, both of them mainly used the box system. In modern stable construction, there has been a move away from the tie stand housing system that was applied in room B2 due to the restriction on the freedom of movement and the lack of possibility for manifesting natural behaviours, which considerably impairs the horse welfare conditions (Fiedorowicz et al., 2004; Fiedorowicz, 2007b; Jodkowska, 2007; Łojek, 2014). The minimum dimensions of rooms for small horses with a withers height of up to 1.47 m, established based on animal welfare condition requirements taking into account the withers height, should be 6.0 m2 for boxes, and 1.6 x 2.1 m for tie stalls (Pirkelman et al., 2010). It follows from the data presented in Table 1 that all boxes and tie stalls complied with the standards set for individually kept horses. In room B3, in which mares with foals as well as the young stock in pairs were housed, the requirements for the box area were not met, as for a mare with a suckling foal, the area should be a minimum of 12 m2, while in group boxes for the young stock, it should be 9 m2/head.

When assessing welfare, however, it must be taken into account that these standards are provided for large horses. Moreover, virtually from April to November, the horses at Centre B are kept outside in enclosures and on pastures 24 hours a day. When making an inventory of stable B3, however, a defective design of the boxes was noted, as the doors to the boxes opened inwards. Given the bedding material in the boxes as well as the presence of horses, opening the door in such a way could considerably hinder the handling of animals. The area of the boxes at Centre A and in stable B4 was considerably greater than that reported by other authors (from 8.4 m2 do 10.5 m2), even though their studies concerned rooms intended for horses of a larger size than the Felin ponies (Bombik et al., 2009a; Kwiatkowska-Stenzel et al., 2011; Łuszczyński et al., 2017).

Topczewska and Rogowska (2017) demonstrated that, in selected stables, it was possible to find boxes considerably greater than the standard provides for, with an area of approx. 16 m2, corresponding to the boxes found in room B4 at Centre B. The tie stalls in room B2 were longer and narrower than those observed by Bombik et al. (2009a) in their study. Both the surface and cubic volume index values were greater in the stable at Centre A than in the rooms at Centre B. This could be due to individual horses housing in boxes with a large area, a wider feed and manure corridor and the design of the roof space in stable A as compared to the rooms at the second centre, in which the boxes were generally lower, with the horses being occasionally housed in them in pairs, the transport routes were narrower, and the presence of a usable attic reduced their cubic volume. The varying index values in the stables at Centre B also resulted from the fact that these rooms had previously had a different purpose, and their adaptation for the horse housing purposes could not always be efficient.

In the stable at Centre A, and in room B1 at Centre B, similar to the study by Bombik et al. (2011), the surface indices were higher than the values provided by Łuszczyński et al. (2017) and Bombik (2009a), ranging from 7.1 to 16.8 m2/head, which, on the other hand, were more consistent with those determined for the remaining stables at Centre B. A similar trend was observed for the cubic volume index. Its values, determined for stables A and B1, appeared to be higher as compared to the standards indicated by Kośla (2011) (24-45 m3), and were not met by rooms B2 and B3. However, it should be taken into account that these standards are usually set for large horses, and it is possible that a cubic volume index value oscillating at the boundary of the lower range has no adverse effect on the Felin ponies' welfare. A similar value of the cubic volume index (24.8 m3) in the stable for Hucul ponies, which are similar in size to Felin ponies, was determined by Łuszczyński et al. (2017).

In the rooms in the centres under study, natural lighting additionally supported by artificial lighting was introduced in order to provide the horses with access to light. At Centre A, double-glazed plastic windows were mounted, while Centre B had wood-framed, single-pane windows. At the former centre, in view of the riding arena adjacent to the stable building, the windows on one side were obstructed and failed to fulfil their function, which translated into a low natural lighting index value (W:F=1:21). At Centre B, rooms B2 and B4 complied with the natural lighting standards set by Kośla (2011) (W:F=1:12-25). However, the requirements for an optimum window-to-floor area ratio of 1:15 for breeding horses, or 1:12 for mares with foals, reported by some authors (Fiedorowicz et al., 2004; Fiedorowicz, 2007a; Jodkowska, 2007; Kośla, 2011), were only met by stable B2.

What was worrying in this regard were the results for rooms B1 and B3, which did not meet these requirements and considerably exceeded the established ranges. This was primarily due to the location of these rooms in the building in such a manner that the windows could only be fitted on one wall. For this reason, certain boxes were virtually deprived of natural lighting. This applies in particular to stable B3 in which the natural lighting index was as low as 1:64, despite the fact that mares with suckling foals and the young stock were kept in this room. If it was not technically possible to increase the window area due to the design of the room being converted, these groups of horses should be housed in other, more illuminated stables to ensure their proper development, especially given that Centre B had such rooms.

Earlier studies by other authors demonstrated that only some of the stables being described met the recommended natural lighting standards for mares with foals (Kupczyński & Mazurkiewicz, 2004; Topczewska & Rogowska, 2017). In the majority of the facilities under inventory, this index took values similar to those at Centre A and in room B4 (Bombik et al., 2011; Prokulewicz & Tomza-Marciniak, 2013; Łuszczyński et al., 2017); none of the available studies noted such low natural lighting indices as those in rooms B1 and B3 at Centre B. Where the natural lighting is insufficient, and in order to ensure better organisation of the service staff's work, artificial lighting is usually also used. At both centres, incandescent lighting was used, whose intensity, only for rooms B2 and B4 at Centre B, fell into the range provided by Kośla (2011) of 8-16 W/m2 of the stable area. In the remaining buildings, the artificial lighting index was too low. Although for stables B1 and B3, it fell into the range described by Bombik et al. (2009a, 2011), having considered the natural lighting index in these rooms, it must be concluded that incandescent lighting should definitely be brighter. A very low artificial lighting index value (1.0 W/m2) was noted in a study by Łuszczyński et al. (2017) during an analysis of welfare in a stable for Hucul horses converted from a sheep shed. Only a slightly higher (1.52 W/m2) index value was demonstrated in a newly established stable at Centre A, in which it could appear to be sufficient if it were not for the fact that the riding arena constructed nearby obstructed some windows, which reduced the natural lighting index to a level of 1:21.

Even though the average lighting intensity values in individual stables at the centres under study varied and exhibited a high degree of variability at different measuring points, all of them fell into the range determined by Kośla (2011) as a standard (15-30 lx). Similar results concerning light intensity were obtained by Kupczyński and Mazurkiewicz (2004), Bombik et al. (2009a), and Topczewska and Rogowska (2017), while a study by Bombik et al. (2011) found this index value to be twice as high in the stables, compared to the requirements set down.

The minimum recommended temperature in rooms for horses should not be lower than 5°C (Morgan, 1998; Fiedorowicz, 2007a; Bombik et al., 2009a; Directive of Ministry of Agriculture and Rural Development of the Republic of Poland, 2010), and ideally, it should fall within the range of 7-10°C (Morgan, 1998; Jodkowska, 2007). Horses are adapted to tolerate low temperatures, especially at low air humidity levels, in which less heat is released into the environment (Jodkowska, 2007; Łojek, 2014). If the temperature falls slightly below the standard value, with adequate relative humidity, an excessively low temperature is not expected to have a significant effect on the horses' welfare level. An analysis of the microclimatic indices revealed that the internal temperature in rooms B1, B2, and B3 was higher than that in building A, even though the external temperature at Centre B appeared to be negative (-5.3°C) and highly significantly different from the external temperature at Centre A (4.9°C). Another interesting fact is that the average temperatures in rooms B1, B2, and B3 differed highly significantly from each other, even though these rooms were located in one building.

For Centre A, the average internal temperature was slightly lower than the recommended temperature, even though some of the individual measurements fell into the standard ranges. At Centre B, this index in rooms B1, B2, and B3 fell into the established range, while in room B4, the average internal temperature and all the individually taken measurements appeared to be lower than the recommended value. Internal temperature values similar to those in rooms B1, B2, and B3 were shown in previously conducted research into different stables during the winter period (Bombik et al., 2009a; Kwiatkowska-Stenzel et al., 2011; Bombik et al., 2011; Kośla & Porowska, 2013; Topczewska & Rogowska, 2017).

A highly significant variability in the warmth retention capacity of the buildings under assessment (expressed by the difference between the average internal and external temperature) was demonstrated. The highest average difference between these temperatures was noted for room B1 (18.7°C), while the lowest was noted for Centre A (0.6°C). It is difficult to compare the warmth retention of a newly-constructed building at Centre A with that of the adapted stables at Centre B, as during the study the external temperature at the centres differed considerably. It is not known what values the internal temperature in stable A (without a usable attic) would take if the external temperature was negative like at Centre B. It was noted, however, that when adapting the rooms which had previously not been intended for horses, it was difficult to obtain identical conditions even where they were located in one building. Assuming that the design of the walls and usable attic were similar throughout the building at Centre B, the different warmth retention capacity of the rooms located in the building could have probably resulted from an incorrectly selected stocking density. This is indicated, e.g. by the high values of both the surface and cubic volume indices in stable B1, which was characterised by the lowest warmth retention capacity.

Regulations on the minimum animal housing conditions (2010) limit the maximum relative humidity for rooms for horses at 80%. However, according to various authors, the zootechnical standards commonly accepted for this index ranged from 30% to 70% (Jodkowska, 2007; Łojek, 2014). Other authors have also confirmed that the normal relative humidity range can be very wide and range from 57% (Bombik et al., 2011) to 94% (Kwiatkowska-Stenzel et al., 2011). The average relative humidity in the stable at Centre A was the highest (78.1%). Even though it was found during individual measurements that the standards for maximum values of 80% were exceeded, the average value of this index was within the permissible range. The average relative humidity in individual rooms at Centre B was in line with the established standard and was lower in each case compared to Centre A. The average relative humidity values for rooms B1 and B2 (30.4% and 37.9%, respectively) were lower than those noted in other studies (Bombik et al., 2009a; Bombik et al., 2011; Kwiatkowska-Stenzel et al., 2011; Kośla & Porowska, 2013; Topczewska & Rogowska, 2017). It was observed that, at Centre A, the average internal temperature values were low, while the relative humidity was high. According to Kośla (2011), such a microclimate can reduce the horses' resistance and decrease the nutrient digestibility. In stable rooms at Centre B, the internal temperature and relative humidity values can be regarded as normal, even though it was noted that a higher temperature was correlated with a lower relative humidity.

A statistical analysis of the air movement velocity measurements demonstrated a number of significant and highly significant differences between the rooms at Centre B. Nevertheless, the results of the current study are, in most cases, consistent with the results of the studies by Łojek et al. (2005) (0.15-0.35 m/s) and by Fiedorowicz and Łochowski (2008) (0.28 m/s), concerning the air movement in rooms for horses under winter conditions, even though Kwiatkowska-Stenzel et al. (2011) demonstrated considerably greater ranges of this parameter values (0.04-0.70 m/s). Kališek et al. (2013) determined that the optimum air flow rate value should be 0.25 m/s, and no less than 0.15 m/s.

The animal welfare condition standards specify a maximum permissible air movement velocity in stable buildings at a level of 0.3 m/s. (Regulation on the minimum animal housing conditions, 2010). In rooms B1, B2, and B4, it was found during individual measurements that certain values were higher. However, the average values for individual rooms did not exceed the recommended level. Measurements at Centra A demonstrated no air movement in the stable, which might have been due to an insufficient range of the measuring instrument (the measuring range of 0.1-30.0 m/s) or malfunctioning ventilation in the building. Due to the unfinished implementation of a design for a new stable, only the window ventilation system was used in it. Therefore, when closing the windows during the winter period, a lack of air circulation may have occurred periodically, which could explain the results obtained.

At both centres, it was found that the standard for carbon dioxide levels in the air (which, according to the regulation on the minimum animal housing conditions [2010], amounts to 3000 ppm) was not exceeded. According to Fiedorowicz and Łochowski (2008), the average CO2 concentration in the stable under winter conditions was over 1500 ppm, and was significantly correlated with the internal humidity. This study noted the highest carbon dioxide concentration in room B3 with the highest stocking density of horses, and the relative humidity was at an average level of approx. 54%.

Conclusion

In conclusion, it can be stated that at both centres, the areas of boxes for Felin ponies kept individually were within the ranges of the recommended standards. At Centre B, as regards mares with foals and the young stock kept in pairs in boxes, these standards were not met. In all stables, the average internal temperature, the relative humidity, the air movement velocity, the carbon dioxide concentration and the lighting intensity were consistent with the horse welfare requirements, in contrast to the natural lighting index, which, with the exception of the tie-stalled stable B2, was very low and forced the application of an artificial lighting support system.

In general, the surface and cubic volume indices in the stables satisfied the recommended standards. As regards the tie-stalled stable B2 and the boxed stable B3, given that the standards are usually set for large horses, the excessively low cubic volume index value could have had no significant effect on the Felin ponies' welfare. In terms of the buildings, the box area, and the surface and cubic volume indices, the newly constructed box stable at Centre B met the welfare standards related to horse housing to a greater extent than the converted rooms at Centre B, which had a better microclimate. The study results suggest that the original intended purpose of the buildings may have had an effect on the quality of the horse-keeping conditions. Particular attention needs to be paid to the parameters concerning the assessment of horses' living environment not only when adapting old buildings but also when constructing new stables. In order to maintain the appropriate welfare level, it is not only the financial possibilities of the investor or owner of the former stable that are important but, above all, knowledge that allows a compromise to be reached between satisfying the horse's needs and human possibilities.

References

B o m b i k T., G o r s k i K., B o m b i k E., Malec B. (2009a). Porównanie warunków utrzymania koni w stajni stanowiskowej i boksowej. Acta Sci. Pol., Zoote., 8: 3–10.

B o m b i k T., M a l e c B., G o r s k i K. (2009b). Systemy i warunki utrzymania koni w aspekcie dobrostanu. Prz. Hod., 8: 31–33.

B o m b i k E., B o m b i k T., F r a n k o w s k a A. (2011). Evaluation of selected parameters of horse stabling environment in box-stall stables. Acta Sci. Pol., Zoot., 10: 13–22.

C o o p e r J.J., M c D o n a l d L., M i l l s D. (2000). The effect of increasing visual horizons on stereotypic weaving: implications for the social housing of stabled horses. Appl. Anim. Behav. Sci., 69: 67–83.

F i e d o r o w i c z G. (2007a). Wymagania dotyczące warunków środowiskowych w chowie koni. Prob. Inż. Rol., 4: 133–138.

F i e d o r o w i c z G. (2007b). Nowoczesne technologie utrzymania koni. Probl. Inż. Rol., 1: 41–50.

F i e d o r o w i c z G., Ł o c h o w s k i B. (2008). Mikroklimat stajni w okresie zimowym. Probl. Inż. Rol., 4: 127–137.

F i e d o r o w i c z G., Ł o j e k J., C l a u s e n E. (2004). Budowa nowych stajni i modernizacja budynków inwentarskich dla koni. Prz. Hod., 12: 17–20.

H e r b u t E., W a l c z a k J. (2004). Wpływ środowiska na dobrostan zwierząt. Zesz. Nauk. Prz. Hod., 73: 19–40.

H u g h e s B.O., D u n c a n I.J.H. (1988). The notion of ethological "need," models of motivation and animal welfare. Anim. Behav., 36: 1696–1707.

J e z i e r s k i T., G ó r e c k a A. (2007). Dobrostan koni sportowych i rekreacyjnych. Hodowca i Jeździec, 3: 40–44.

J o d k o w s k a E. (2007). Wskazania przed rozpoczęciem budowy ośrodka hippicznego. Hodowca i Jeździec, 5: 30–37.

K a l i š e k J., K n i a ž k o v a I., O n d r P., Š o c h M. (2013). Evaluation microclimate in the stable national stud farm in Kladruby nad Labem. Acta Univ. Cibiniensis. Series E: Food Technol. 17: 77–87.

K a m i e n i a k J., S o ł t y s L. (2013). Ocena behawioralna i użytkowa kuców felińskich. Prz. Hod., 3: 29–34.

K o ś l a T. (2011). Metodyka badań z higieny zwierząt i prewencji weterynaryjnej. Wyd. SGGW, Warszawa.

K o ś l a T., P o r o w s k a A. (2013). The welfare of horses assessed by the investigations of chosen parameters of the stable microclimate. Ann. Warsaw Univ. of Life Sci. SGGW, Anim. Sci., 52: 67–75.

K u p c z y ń s k i R., M a z u r k i e w i c z J. (2004). Ocena warunków mikroklimatycznych w dwóch obiektach hodowli koni. Zesz. Nauk. Akad. Rol. Wroc., Zoot., 51: 165–171.

K w i a t k o w s k a - S t e n z e l A., S o w i ń s k a J., M i t u n i e w i c z T., I w a ń c z u k - C z e r n i k K., W o j c i k A., R a d z y m i ń s k a M. (2011). The comparison of horses management conditions in the box stall stable and the horse-barn. Pol. J. Natur. Sci., 26: 27–36.

Ł o j e k J. (2014). W trosce o dobrostan naszych koni. Hodowca i Jeździec, 43: 46–49.

Ł o j e k J., K o l b u s z o w s k i T., Q u e i r o z P., D a n i l u k I., G a j d a A. (2005). Microclimate parameters and thermal balance of common type stable in Poland adapted from old cowshed. Proc. XII Int. Cong. Anim. Hyg., ISAH, Warsaw, Poland, 4-8.09.2005, ss. 493–496.

Ł u s z c z y ń s k i J., K o n d r a c k a J., P i e s z k a M., D ł u g o s z B., S t e f a n i u k - S z m u k i e r M., J a k l i ń s k a B. (2017). Ocena budynków i infrastruktury w Stadninie Koni Huculskich Gładyszów pod względem dobrostanu utrzymywanych w nich koni. Prz. Hod., 3: 8–13.

Max A. (2003). Zaburzenia oddechowe u nowonarodzonych źrebiąt. Mag. Wet., 80: 27–29.

Mellor D.J. (2016). Updating animal welfare thinking: Moving beyond the "Five Freedoms" towards "A Life Worth Living". Animals, 6: 21.

Morgan K. (1998). Thermoneutral zone and critical temperatures of horses. J. Therm. Biol., 23: 59–61.

Pirkelmann H., Ahlswede L., Zeitler-Feicht M. (2010). Hodowla koni: organizacja stajni i żywienie. Wyd. RM, Warszawa, 200 ss.

Prokulewicz A., Tomza-Marciniak A. (2013). Evaluation of selected physical parameters of air in autumn in stables of Nowielice Stud Farm. Acta Sci. Pol. Zoot., 12: 79–86.

Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z dnia 28 czerwca 2010 r. w sprawie minimalnych warunków utrzymywania gatunków zwierząt gospodarskich innych niż te, dla których normy ochrony zostały określone w przepisach Unii Europejskiej. (Dz.U. Nr 116, poz. 778).

Topczewska J., Rogowska A. (2017). Assessment of housing conditions in selected horse stables. Scient. Ann. Pol. Soc. Anim. Prod., 13: 67–75.