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# Evaluation of Temperature-Humidity Changes in Closed Type Water Buffalo Barns in Terms of Animal Welfare

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## ABSTRACT

The aim of this study was to evaluate temperature and relative humidity changes in closed type buffalo barns for different seasons in terms of animal welfare. In this study, two Anatolian Water Buffaloes group, which were assumed to have the same genetic similarities were formed based on their age and lactation number. One of this groups was housed in the Barn-I, where the climatic environment was controlled at an optimum level, and the other was housed in the Barn-II under current farming conditions. The amount of area and internal volume per buffalo in the barns were kept equal. As a result of the research, it was determined that the indoor temperature and relative humidity values were not a problem in terms of animal welfare in the Barn-I. For Barn-II, the increase in the relative humidity of the indoor environment during the winter months and the fact that the temperature was above 25 ° C in the summer had a negative effect on animal welfare. It is suggested that a good ventilation and misting system should be planned together in closed buffalo barns especially in winter and summer months in order to control the climatic environment at an optimum level.

***Keywords—****Anatolian Water Buffalo, Closed type barn, Animal welfare, temperature, relativehumidity*

## I. INTRODUCTION

In order to increase animal production, it is essential to improve and optimize the indoor climatic environment conditions while trying to increase the yield potential of animals by feeding and genetic improvements [1]. Because many scientific studies have shown that the effect of genetic structure on yield is around 30% and feeding and housing conditions are around 70% [2, 3]. There are very few places in the world that will consistently provide optimum climatic conditions for livestock all year round. Therefore, the effects of climatic conditions deviating from the optimum situation on animals are investigated and suitable climatic conditions for optimum production are continuously investigated.

Temperature is the most important environmental factor affecting the physiological activities of animals. Because temperature is an important index to affect the health and comfort of animals. The temperature range in which animals can perform and produce their productive functions in the best way is defined as the 'Comfort Zone ve and covers a narrow temperature range [4]. As you move away from the comfort zone, cold stress starts at low temperatures and temperature stress starts at high temperatures. Both stress conditions can adversely affect the meat and milk yield of livestock. It is recommended that the indoor temperature of the comfort zone and the thermo-neutral zone for water buffaloes is between 2-21 ° C and the upper limit value for physiological thermo regulator mechanism is 27 ° C [5].

One of the important environmental conditions for animal welfare is relative humidity. The effect of relative humidity on animals, which varies within certain limits at certain temperatures, is related to indoor temperature. Generally, high temperatures and relative humidity create anorexia in animals, reducing the consumption of feed required by animals for maximum productivity [6]. In optimum conditions, the relative humidity should be between 60-80%. The relative humidity should never be less than 30% and more than 90% [7].

The aim of this study was to evaluate temperature and relative humidity changes in closed type buffalo barns for different seasons in terms of animal welfare

## II. Material and Method

This study was conducted in a water buffalo farm which is located in Thrace Part of Istanbul Province. The study area is located at 41° 12' northern latitude and 28° 44' east longitude and average altitude from sea level is 119 m. [8]

In the selected farm, two water buffalo groups which were assumed to have genetic similarities were formed. One of this groups was housed in the Barn-I, where the climatic environment was controlled at an optimum level, and the other was housed in the Barn-II under current farming conditions. The amount of area and internal volume per buffalo in the barns were kept equal., The temperature and relative humidity values of the indoor and outdoor air were measured for 24 hours along a year with thermo-hygrometer at 10minute intervals in the both barns. In order to prevent heat stress in controlled barn conditions (Barn-I), a misting system was installed and the indoor temperature was kept around 25 $^{o}$C. The obtained data were compared with literature values for different seasons and evaluated in terms of animal welfare.

## III. Result and discussion

The amount of heat and water vapor produced by the animals in the barns varies depending on the temperature and humidity values of indoor environment. For this reason, when the thermal environment control is not sufficient in the barn, animal welfare is adversely affected as a result of the negative impact of heat stress, effective utilization of the genotypic potential decreases and results in yield losses [9]. Considering the climatic conditions of the region where the research was carried out, indoor temperature of 13 ° C and indoor relative humidity of 75% were suitable for the winter season in closed buffalo barns. Daily changes of avrege temperature and relative humidity values of Barn-I, Barn-II and outdoor air in the winter season were given graphically in Figure 1 and Figure 2.

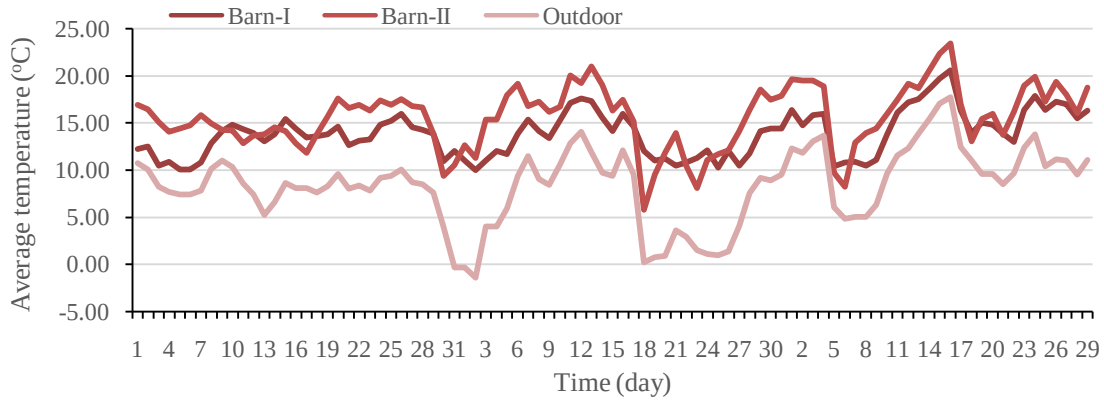


Fig.1. Average temperature valuesof the indoor and outdoor air in winter months

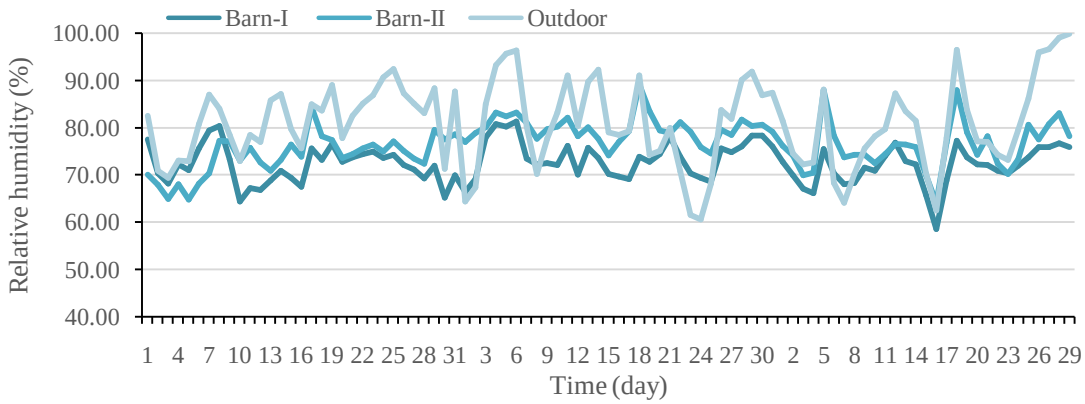


Fig. 2. Average relative humidity values of the indoor and outdoor air in winter months

In Figure 1, the lowest and highest average temperature values were 10 $^{o}$C and 20.5 $^{o}$C in Barn-I, 5.4 $^{o}$C and 23.4 $^{o}$C in Barn-II, respectively. Indoor temperatures for both barns were at suitable levels. However, while the average temperatures of Barn-I varied among narrower limits, this values changed among the wider limits in Barn-II. The lack of ventilation chimneys in the Barn-II and the use of windows for ventilation caused difficulty to control indoor temperature and deviations from the optimum temperature of 13 ° C that we accept for water buffaloes. The average temperature values of outdoor varied between -0.34 $^{o}$C and 17.7$^{o}$C.

When the indoor relative humidity values were examined in Figure 2, it varied between 64.5% and 81.4% in the Barn-I, while these values varied between 64.8% and 89.2% in the Barn-II. The indoor relative humidity values of Barn-I had not any problem for water buffalo welfare for the winter season. However, it has seen that these values were above the acceptable limits in Barn-II. Too high or too low relative humidity may adversely affect the thermoregulatory ability of animals and consequently deteriorate animal health [10]. The outdoor relative varied between 60.5% and 99.8% during the winter months.

Daily changes of avrege temperature and relative humidity values of Barn-I, Barn-II and outdoor air in the spring season were given graphically in Figure 3 and Figure 4.

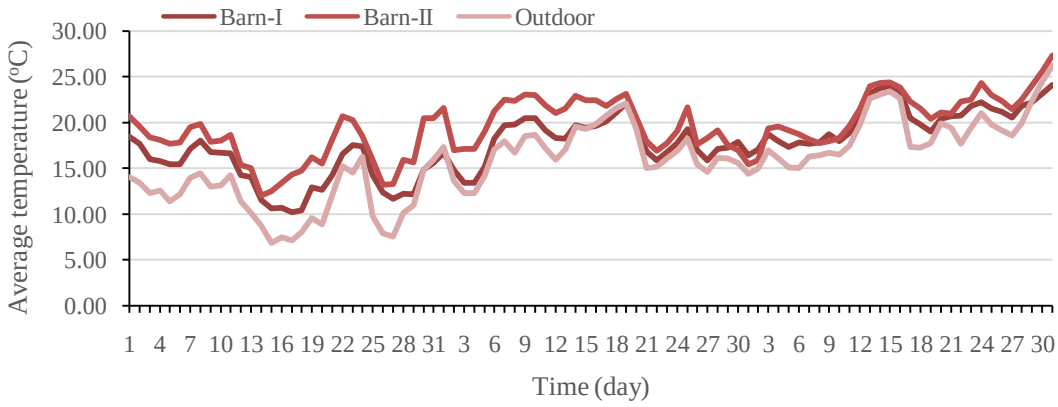


Fig. 3**.** Average temperature values of the indoor and outdoor air in spring months

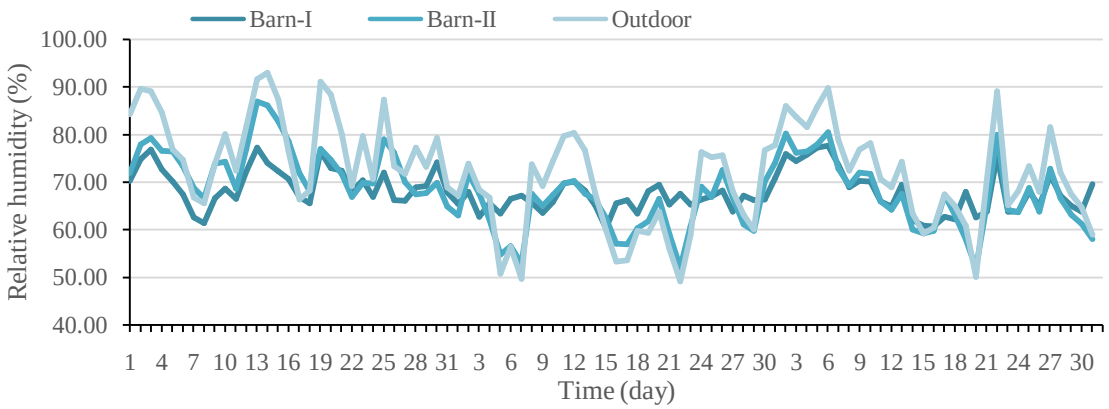


Fig. 4. Average relative humidity values of the indoor and outdoor air in spring months

In Figure 3, the lowest and highest average indoor temperatures were 10.2 $^{o}$C and 23.1 $^{o}$C in Barn-I, 10.7 $^{o}$C and 27.4 $^{o}$C in Barn-II, respectively. According to the suggested indoor temperature value of 18 $^{o}$C, the average temperature values in Barn-I were not at a level that cause a stress for the water buffaloes. The recorded values for Barn-II were sometimes above the optimum temperature. When the relative relative humidity values were examined in Figure 4, it varied between 60.7% and 77.6% in Barn-I, while it varied between 52.1% and 86.9% in Barn-II. When the relative humidity values were compared with 75%, it could be said that the relative humidity values of Barn-I had not any problem for water buffalo welfare. It has seen that these values were above the acceptable limits for Barn-II.

Daily changes of average temperature and relative humidity values of Barn-I, Barn-II and outdoor air in the summer season were given graphically in Figure 5 and Figure 6.

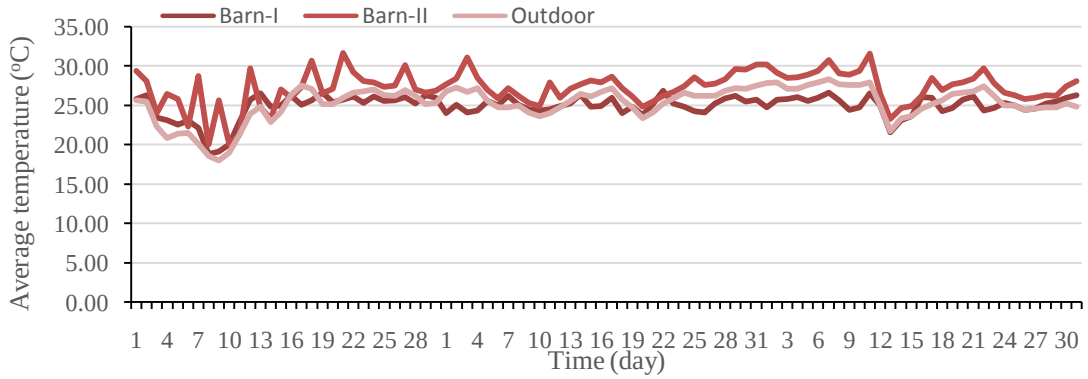


Fig. 5.Average temperature values of the indoor and outdoor air in summer months

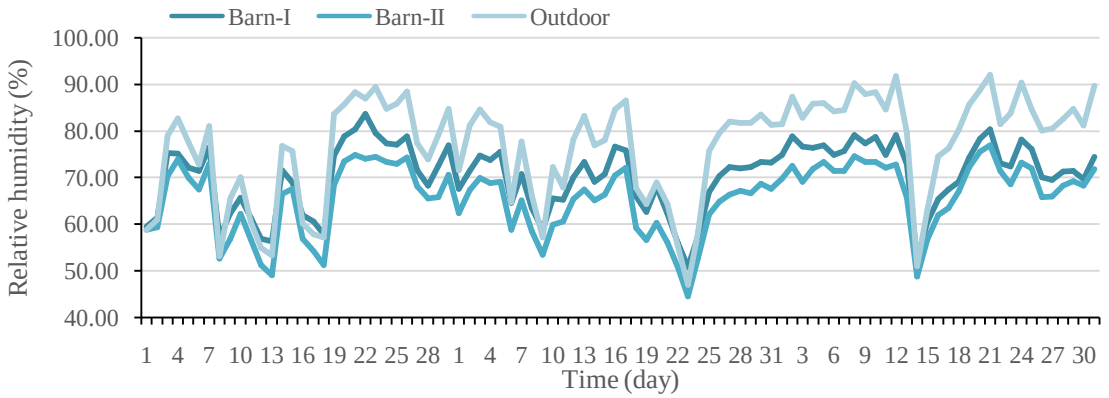


Fig. 6. Average relative humidity values of the indoor and outdoor air in summer months

When Figure 5 was examined, the lowest and highest average indoor temperature were 18.82 °C and 26.84 °C in Barn-I, 20.02 °C and 31.66 °C in Barn-II, respectively. the average indoor temperature values could be kept at suitable levels by the effect of the misting system in the Barn-I. It has been also seen that there was a slight deviation from 25 °C which is accepted as the optimum design criteria in summer conditions. In Barn-II, the average indoor temperatures varied among wider limits. This situation caused to an increase in temperature stress of water buffaloes, resulting in reduced feed consumption and reduced milk yield. When the average relative humidity values were examined in Figure 6, it varied between 50.81% and 83.55% in the Barn-I, while these values varied between 44.53% and 76.92% in the Barn-II. When the optimum relative humidity values accepted for the summer season were compared with 80%, it has been seen that the average relative humidity values of Barn-I were slightly higher by the effect of the misting system. However, it could be said that water buffalo welfare was not at a level that would cause too many problems. In Barn-II, the average indoor relative humidity values were positive for animal welfare.

Daily changes of average temperature and relative humidity values of Barn-I, Barn-II and outdoor air in the autumn season were given graphically in Figure 7 and Figure 8.

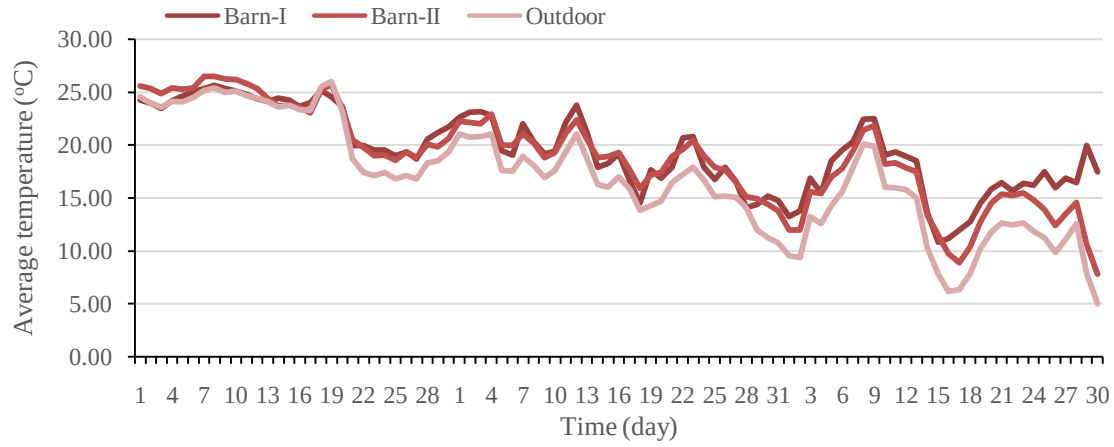


Fig. 7. Average temperature values of the indoor and outdoor air in autumn months

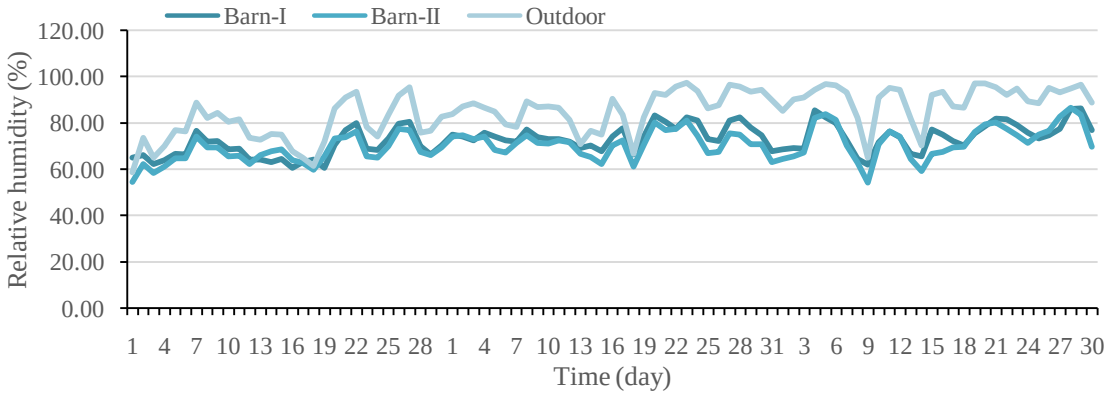


Fig. 8. Average relative humidity values of the indoor and outdoor air in autumn months

When Figure 7 was examined, the lowest and highest average temperatures were 10.87 °C and 25.69 °C in Barn-I, 7.81 °C and 26.54 °C in Barn-II, respectively. Based on the optimum temperature of 18 ° C for the transition season, the recorded average temperature values were not at a stress level for animal welfare in Barn-I and Barn-II. When the average relative humidity values were examined in Figure 8, it varied between 60.51% and 86.12% in the Barn-I, while it varied between 54.24% and 86.56% in the Barn-II. When the relative relative humidity values were compared with 75%, it could be

said that the relative humidity value changes of the Barn-I and Barn-II induced partial problems for water buffalo welfare.

## IV. CONCLUSİONS

In this research, the effects of the on temperature and indoor relative humidity value changes on animal welfare were investigated for different seasons. According to the obtained data, the temperature and relative humidity values were not a problem in terms of buffalo welfare under controlled barn conditions for all seasons. For current farming conditions, the increase in the indoor relative humidity for the winter season and the indoor temperature above 25 $^{o}$C in the summer season had a negative effect on the animal welfare. In order to control the climatic environment at an optimum level, a good ventilation system should be planned in closed buffalo barns. In addition, in order to eliminate the heat stress that may occur during the summer months, it will be beneficial to install a misting system in the barn or in the paddock area.

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## REFERENCES

[1] I. Kocaman, A Research on the Investigation of the Physical Status of the Tie Stall Dairy Cattle Barns and Environmental Condition in Inanlı and Turkgeldi Livestock Farming Administrations, PhD Thesis, Thrace University, Institute of Natural and Applied Sciences, Edirne, 1998.

[2] A.V.Yaganoglu, 'Regulation of environmental conditions in animal barns', Journal of Atatürk University Faculty of Agriculture, 1986(17), 1-4.

[3] T. Ekmekyapar, Regulation of Environmental Conditions in the Animal Barns, Atatürk UnivesityScience, Erzurum, 1991.

[4] M. Okuroglu, and L. Delibas,'Suitable environmental conditions in the animal barns', Turkey, vol.2, pp. 142-149, May 1986 [Symposium of Animal Husbandry, Turkey, p. 405, 1986].

[5] M. M. Shafie, Physiological Responses and Adaptation of Water Buffalo, Florida, USA, CRC, 1985.

[6] N.H. Noton, Farm Buildings. London: College of Estate Management, 1982.

[7] C.H.Wathes and D.R. Charles, Livestock Housing. UK: Animal Science and Engineering Division Silsoe Research Institute.1994.

[8] Anonymous,Meteorological Data in Catalca District of Istanbul Province. Metorology General Directorate, Ankara, 2019.

[9] S.Mutaf, S.Alkan and N. Seber, 'Design principles of animal shelters in ecological agriculture', Turkey, vol 2, pp. 212-230, July 2004 [1'st International Congress on Organic Animal Production and Food Safety,Turkey, p. 325, 2004].

[10] S. Mutaf, The Climatic Environment and Detection Principles of Animal Barns with Engineering Approach, First edition, vol.1. Ankara, 2012, pp. 236-243.