

Effect of cattle stable environment in terms of welfare

ANNA SIMKOVA, KATERINA SVEJDOVA, MILOSLAV SOCH, KRISTYNA SIMAK
LIBALOVA, LUBOS ZABRANSKY

Department of Animal husbandry sciences
University of South Bohemia in Ceske Budejovice
Studentska 13, 37005 Ceske Budejovice
CZECH REPUBLIC

anna-simkova@seznam.cz

Abstract: The high summer temperatures and high humidity can negatively affect stabled animals and cause thermal stress. The combination of high temperatures and humidity represents a burden. It is especially for dairy cows, which get rid of excess heat too difficult. The negative effect of heat stress for dairy cows is reflected, for example, worsening health condition, reproduction and reduced of milk production. Using the stable reconstruction is possible affect the microclimate of stable and meets the demands of housed dairy cows to environment, comply with welfare. Among the methods used for cooling of dairy cows include the installation of an active cooling system with fans. In the experiment was used of DeLaval fans DF 1300 in the stable for cows and heifers of the breed Holstein, which were added to the current cooling system. It was measured air flow using Testo 425 in the stable. It is the thermal anemometer with permanently attached thermal probe. The experiment was carried out during two years. It was collected a primary data in the first year. The additional fans were installed in the second year. The values of air flow were compared with the total milk production for the period 2013 and 2014. The air flow was slightly reduced and the direction of airflow was streamlined in the stable. The resulting values showed a positive effect on the milk production, which constantly increased in the second year of the experiment. In the warm months of the year it was created for dairy cows and heifers adequate climatic environment in the stable, which was reflected by an increase in milk production.

Key-Words: stable microclimate, air flow, ventilation, heat stress, dairy cows, milk production

Introduction

The stable microclimate is defined as a condition of stable environment, which is consisted by the file of physical, chemical and biological elements. One of the important physical factors influencing stabled animals is the speed of air flow [1].

Among the factors affecting the microclimate of stable are sorted for example: the number of animals in the stable, method of solving peripheral construction of stable in terms of its thermal insulation properties, the intensity of ventilation or stable position in the terrain due to the prevailing winds and climatic region [2]. In the temperate zone of Central Europe were recorded significant losses in milk production. The reason is a combination of high temperature and humidity. As a result of the combination of these factors is exerted a burden on the body of dairy cows, which stabled animals feel in the form of excess heat [3].

In the animal husbandry should therefore be providing conditions that allow them to not only express their natural behavior but also to cope with environmental conditions [4]. In ensuring of suitable

welfare can stabled animals express positive and negative feelings at the same time [5], which is finally reflected in the total production. The production is directly proportional to the stress, because the animals spend a part of their energy to overcome of stressful situations. The production is decreases with increasing stress [6].

The loss of milk production can be prevented with the suitable stable environment, which can be achieved for example ventilation. Ventilation can be natural and artificial. Natural ventilation is achieved by the correct orientation of the stable using the prevailing wind direction.

Among the methods of artificial ventilation are sorted passive elements of ventilation such as heat insulated roof or ridge vent fissure. The active elements are the cooling fans systems [3].

The value of air flow should not exceed a value above 0.3m/s at lower temperatures [7]. At higher values of air flow is reduced temperature tolerance of housed animals. Heat loss is increased with convection and evaporation from the surface of the body, especially in places that are dirty and wet [8].

At high temperatures is suitable the value of air flow in the range from 0.5m/s to 1.5m/s, which has a favorable effect on the blood circulation and metabolism [7].

The aim of the study was to determine how changes the environment in terms of installation of active cooling system in the stable. If it is possible influence the welfare of dairy cows in relation to the total milk production.

Material and Methods

The experiment was carried out in the stable of Agricultural company Petrovice u Sedlčan a.s. for dairy cows and heifers of the breed Holstein with free boxing barns. Data was measured in the period from April to July 2013 and from April to July 2014. The interval of measurement was one to two weeks. The primary data collection was carried out in the first year of experiment. It was measured airflow in the second year. The values were already affected by installed fans of DeLaval type DF 1300 to improve the welfare of dairy cows and heifers.

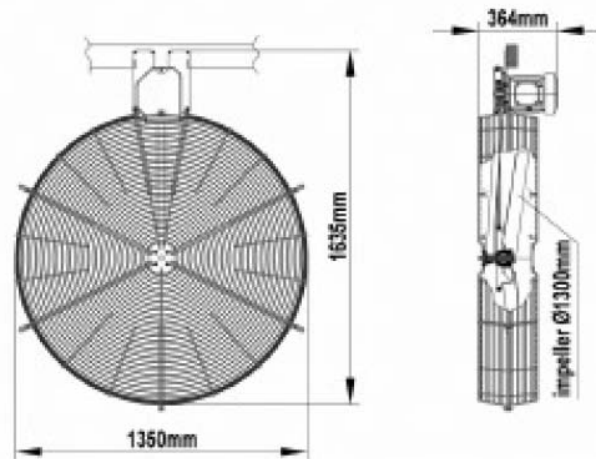
The stable is roughly situated north-south with a ratio of construction 3:1. Thermally isolated part of building is only the roof with ridge slot. In the side profile of the stable there are rolling the sails. Longitudinal profile of the stable is in the implementation phase of opening and installation of automatic sails with weather station. Inside the stable there is the feeding corridor split lengthwise into two halves, each half is further divided into three sections. In the sections there are boxing beds placed in three rows.

The air flow was always measured by thermal anemometer Testo 425 with permanently attached thermal flow probe. The measuring range of the probe is from 0m/s to 20m/s with an accuracy of $\pm 0.03\text{m/s}$ and a resolution of 0.01m/s [9].

The airflow was measured at several locations of environment in the living area of dairy cows and heifers in the stable. The measured values were averaged for clarity. Fans of DeLaval DF 1300 have a diameter of 1300mm with a maximum replacement of air up to $48,500\text{m}^3/\text{h}$. The noise level of running fan is 67 dB. This value does not disturb the peace of stable environment. For the safety the fans are provided with protection cage from all sides. The fans are started automatically by the temperature sensor [10].

Data of total milk production was taken from farm evidence and together with the measured values of airflow recorded in tables and evaluated in a chart in Microsoft Excel.

Fig.1 Fan DF 1300 [10]



Results and Discussion

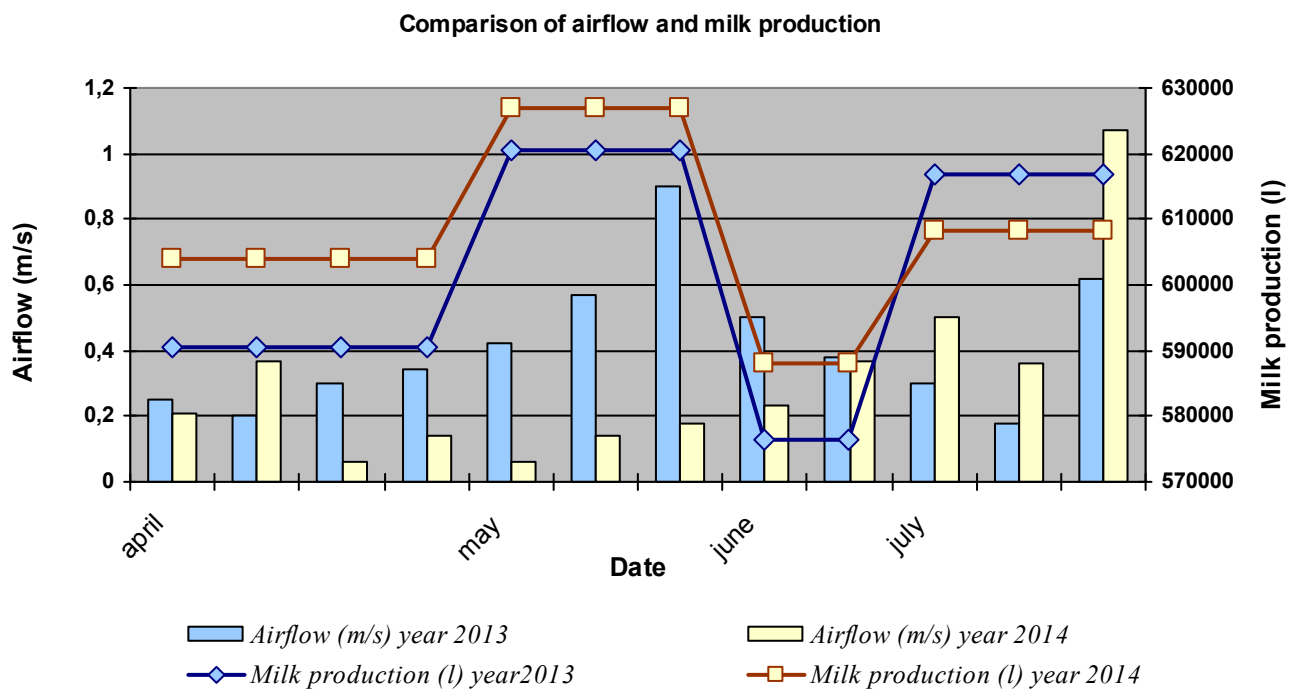
In the Figure 2 are shown the values of air flow measured for stretch period in 2013 and 2014, interspersed with values of milk production for the same period.

The average value of the speed of air flow for 2013 was 0.42m/s. Kurša et al. [11] reported a value above 0.3m/s as undesirable, which may negatively affect stabled animals, for example hypothermia or poor blood circulation in certain parts of the body. However, the measurement was carried out in the period of higher temperatures, where a higher airflow was used for cooling of dairy cows and used for avoiding to heat stress which could reduce milk production.

The stable was oriented in a north-south direction. The suitability of the stable orientation is confirmed by Smith [12] according to it is the best use of natural ventilation. In the side profile there was stable closed with the rolling sails. In the longitudinal profile there was closed by stable windows. Above the middle of lying down double-boxes was used existing cooling of ventilation system. Location of ventilation was justified even by Havlik [3], whose states that the best place to install a fan in the stable is above the center of lying down double-boxes. The main corridor of the airflow is in the middle line of double-boxes, which use dairy cows in days with high temperatures to reduce heat stress. Dairy cows lying a longer time and resting in the stable.

In the following year 2014, the average air velocity decreased by 0.11m/s to 0.31m/s. One of the reasons for the change of air flow velocity in the barn were

Fig. 2 Comparison of airflow and milk production



initiated modifications to improve the welfare of dairy cows. The previously used cross-ventilation of barn, comb slots and existing fans above the centre of lying down double-boxes added new elements of ventilation. Fans DF1300 were installed due to the feeding area. The airflow directed to the animals that were feeding at the time. Havlik [3] in his publication says that the installation of the fans is above the feeder error. Dairy cows stand here longer time, in some cases they even lie down on the floor. In the experimental stable was not negative behavior of dairy cows recorded. Although there was directing air flow velocity an average of 0.11m/s, it was showed a positive effect on total milk production. Lactation has evolved in the opposite trend and overall it increased in the second year of experiment. The increase of total milk production was an average of 5,755 liters. With the results identifies Wells [13], who in his book says that the proper setup and use of ventilation in the barn for dairy cows is possible to achieve of better health and increase milk production. Also Frazzi [14] concluded that adequate optimization of microclimate in the barn during the summer months is possible to increase milk production.

Conclusion

The results of the experiment, which took place in the barn with dairy cows and heifers during two

years shows that the location of the fans above the feeder was justified. Although vertical fans are most commonly placed over the center lying down double-boxes, adding additional the fans to the feeder caused a change in velocity of air in the barn. Positive values were obtained even in milk production. It is therefore possible to attribute positive results in an increase in total milk production ventilation system. In warmer periods of the year it provided the cows and heifers sufficient cooling of the body surface. Animals were less affected by temperature stress. Improved living conditions in the stable were resulted in the resulting evaluation in an increase in total milk production, which is especially useful for breeders.

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