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Article

# Noise level in a cow milking parlor

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**Abstract:** The study took place in a dairy cattle farm with 500 Holstein-Friesian cows. Animals were reared under conditions of a freestall housing system and milked in a 2 × 8 "Herringbone" type milking parlor. Noise level reporting was performed three times during each milking (at start, in the middle, and at the end of milking) during the morning, midday, and evening milkings, every month within one year. The noise level in the working environment was measured by means of a Lutron SL-4023SD sound meter. The highest average noise values were recorded during the winter season, especially during the midday and evening milking, 75–76 dB, with deviations reaching over 80 dB. The next season, in terms of noise level, was the summer season, with average values of 72–74 dB. A study on noise levels in a "fishbone" type milking parlor found average values corresponding to moderately high noise levels, exceeding 65–70 dB. Such levels may negatively affect the welfare of dairy cows, as maximum values above the permissible limits were also recorded, particularly during the winter season. Therefore, it is recommended to optimize technological processes in order to reduce noise levels during milking as much as possible, which is essential both for the operators (milkers) and for the comfort of the animals.

**Keywords:** noise level; dairy cows; milking parlor

## 1. Introduction

Anthropogenic noise has increased at an unprecedented rate over the past century, both on land and underwater. Noise is considered a global environmental pollutant in international law [1,2]. The main parameters that characterize noise are the frequency of sound vibrations (pitch), intensity (power), and duration of exposure. Noise can be considered a stressor if it affects animal behavior, health, and productivity, or causes physiological problems [3].

Noise is described as unwanted sound, continuous or intermittent. Sound is defined with various terms, including frequency, intensity, frequency spectrum, and shape of sound pressure through time [4].

Expansion in technological and technical equipment of industrial farms and other facilities is the most important reason for defining the effect of noise on livestock. It is assumed that the intensifying noise levels negatively affect the behavior and productivity of livestock [5]. In pasture-based cattle farming, noise levels are usually not a problem. However, the increase in road traffic, rail, and air transport routes generates noise that can lead to adverse reactions in dairy cattle. In modern farms

(with high-tech machinery), noise of varying intensities is inevitable [6]. In modern animal husbandry, noise is becoming a growing but not sufficiently reported problem. The noise in intensive animal husbandry premises produced by the ventilation system, feeding alleys, and manure cleaning lines, and by the animals themselves, is a potential stress factor and affects not only the animals but also the staff who service them [7,8]. It has a direct impact on reproduction and feed digestion [7], causing a decline in appetite and milk yield performance [9]. The noise cows are exposed to on farm premises may be from an outside source or from the building itself. Noise originating from ordinary human activity could also have an adverse effect on dairy cows [7]. Noise sources on farms can be complemented by normal activities (doors opening and closing, washing, employee speech, feeding, etc.). Including noise created by mechanical ventilation and animal activity (mounting on fences, chewing them, and the sounds made by the cows themselves) [10, 11]. Supply lines for maintaining the microclimate in the premises, such as: fans, heaters, and automatic curtains [12]. The type of sources and the amount of noise they produce are mainly related to the adopted animal husbandry system [13]. There are sources of noise that are external to the farm. A number of studies have examined how air transport, and especially helicopters, affect farm animals in terms of noise [14]. Livestock buildings, mainly semi-open in type, are a very noisy environment in general. They represent a good living environment for various species of birds; these birds are also a source of noise [15]. The effects of noise on animal performance and behavior depend not only on its intensity or loudness (dB), its frequency (Hz), and its duration and pattern (including vibration potential), but also on the noise perception capacity of the animal species and breed, the age and physiological state of the animal at the time of exposure. It also depends on the animal's experience, what noise it has been exposed to during its life, and the predictability of the acoustic stimuli [16]. Animals are not only exposed to noise, but they also produce noise (biological noise) [17,18]. The types of sounds produced by animals are specific to their species, breed, sex, age, and the overall situation they find themselves in. Animals use specific sounds to respond to different events occurring in their environment and to express different emotional states [12].

The most important measure of productivity is milk yield. Overall noise up to 105 dB, but above 80 dB, results in reduced milk yield, the degree of milk let-down, and feed intake of dairy cows [19]. Sudden noise from aircraft that flies low has high intensity (>110 dB) and during milking, can lead to adverse behavior such as kicking or pushing, which can result in falling of milking machines down or increased catecholamine release and thereby to reduce the effectiveness of the milk let-down reflex, decreasing milking efficiency, increase in quantity of residual milk and to a general reduction in milk yield. The noise generated during the milking process depends not only on the technological equipment of the parlors, but also on their age. The number of animals being milked at the same time and thus the number of places are also important factors. Noise exposure directly depends on the operators' working practices, particularly their working speed (faster work generates more noise), as well as the precision and accuracy of attaching the milking cups (improper attachment can produce unpleasant noise), communication between the operators, and driving the animals to the parlor or other

activities [20]. According to Kauke and Savary [21], the intensity of the noise is, in most cases, unacceptable for the dairy cows, as well as for the operator (milker). Limiting excessive noise is a factor contributing to improving welfare. Noise in the milking facility influences operational efficiency related to improving cow behavior and human-animal interactions. Faster movement as a reaction to noise persists for the first four days of the treatment phase, with some animals expressing indications of habituation by the fifth day [22]. Reactions to noise in commercial milking parlors may be affected by the process of habituation. Because dairy cows are exposed on a regular basis to the conditions in the milking parlor, animals have the capacity to reduce any fear responses resulting from noise exposure. If the noise level in the milking parlor is too high, the animals become crowded, restless, and cannot be fully milked, leading to the development of udder infections [23]. Noise in livestock farming, and in particular in dairy cattle farming, is an often-neglected problem. Given the modernization of intensive dairy cattle farming with various increasingly modern machines and devices related to performing daily farm activities (such as cleaning, feeding, milking, etc.), in order to largely facilitate human labor and improve production efficiency, as well as to ensure better animal welfare, all this leads to an increase in noise levels on farms (noise pollution). There is a probability that noise will have a negative impact on both workers and farmed animals. This, in turn, will lead to a decrease in the economic efficiency of production and financial losses [24].

The aim of the conducted research was to report the noise level in a milking parlor and to determine whether there was a danger of reaching noise levels causing stress to dairy cows.

## 2. Materials and methods

The study was carried out in the milking parlor of a farm for dairy cattle with 500 Holstein-Friesian animals. The milking parlor was a “herringbone” type with 2 × 8 units, and the milking installation was in use for 10 years. The length of a milking was about 2.5 h, three times a day. The morning milking started at 05:00, midday at 12:00, and evening at 18:00.

Noise level was reported three times a day in each milking (at the start, in the middle, and at the end of the milking). These measurements were repeated every month for one calendar year. Noise was measured at the level of the animals in the middle of the milking parlor.

The noise level in the working zone was measured by Lutron SL-4023SD (**Figure 1**).

For basic statistical data processing, the MS Excel package was used, and to calculate the mean values, errors, and analysis of variance, the corresponding STATISTICA (version 10) modules of StatSoft were used. To evaluate data for homogeneity, the Kolmogorov-Smirnov test was used.


**Figure 1.** Lutron SL-4023SD.

To assess the influence of the factors, the following model was used:

$$Yijkl = \mu + Si + Mj + Pk + eijkl$$

Where:

*Yijkl* was the dependent variable (noise level); $\mu$ was the mean for the model; *Si* was the effect of the season of reporting, *Mj* was the effect of the consecutive milking for the day, *Pk* was the effect of the consecutive reporting during milking, and *eijkl* was the effect of the uncontrolled factors (error).

By analysis of variances (ANOVA) for the model, classes of the fixed factors were obtained: "season of reporting", "consecutive milking for the day", and "consecutive reporting for the milking".

## 3. Results and discussion

**Table 1** presents the average and maximum noise level values recorded in the milking parlor (at the start of milking), in the cow building, and outside the premises. The background noise levels outside range from 46.2 dB, reported in winter, to 61.57 dB, reported in summer. The reported relatively low noise levels in the area of the farm were due to the fact that it was outside a populated area, away from roads with heavy traffic and other industrial noise sources. The average noise levels reported in the cow premises were higher than those reported outside, but by a small difference. On average, the noise level indoors was about 10 dB (from 4 to 11.4 dB) higher than outside. By seasons, the same trend was reported as for the noise level outside. The highest noise level was reported in summer—72.98 dB, and the lowest in winter—54.87 dB. In all seasons, with the exception of autumn, the differences between the recorded average noise levels outside and inside the animal premises were statistically significant (at $p < 0.05$). The higher noise level in the premises was mainly due to the noise created by the animals. The noise measurement was outside the time when the fodder was set with mobile equipment. In summer, the higher noise levels were associated with the running of the fans to cool the animals, which helped to increase the noise level. Due to the large capacity of the farm, the volume of activities that were carried out was large.

All this was accompanied voluntarily or involuntarily with the production of noise. All these activities happened voluntarily or involuntarily with the production of noise. The risk of chronic stress in animals due to prolonged exposure to noise is a common and neglected problem. Long-term exposure to noise can lead to impairment of dairy cow welfare, behavioral disorders, or the development of anxiety and fear. Noise can cause changes in physiological parameters (increased heart rate, increased cortisol levels [25], which leads to compromised immunity and pathological changes, and hence a decrease in productivity (lactation, fattening, delayed estrus, etc.) [12]. Algers and Jensen [26] found reduced milk yield in dairy cows exposed to 1.4 hours of 80–100 dB noise twice daily. Vocalization of animals is important for communication between them; this is how they communicate [27]. Weeks et al. [13] recorded average vocalization levels from cattle in the range of 80 to 90 dB. The same authors measured noise levels of 75–90 (average 84) dB in a cattle building. Usually, the sources of harmful noise in cattle buildings are different: feeding 104–115 dB, mating 94–115 dB, cleaning 105 dB, feed mixing 88–93 dB [28]. An internal source of noise is the farm staff. Various shouts, loud conversations, calls, whistles, singing, and playing the radio (including various types of music) to make the work more enjoyable can cause stress in cattle [29]. Exposing animals to unfamiliar noises can cause stress [30]. Prolonged sound exposure can affect the health of animals.

**Table 1.** Average and maximum values for noise level (dB) in the milking parlor, in the animal premises, and outside by seasons.

| Season | Number | In the milking parlor | | In the animal premises | | Outside | |
|---|---|---|---|---|---|---|---|
| | | x ± SE | max | x ± SE | max | x ± SE | max |
| Summer | 9 | 72.92 ± 1.38a | 78.30 | 72.98 ± 0.43b | 74.40 | 61.57 ± 1.03ab | 67.10 |
| Autumn | 6 | 70.40 ± 1.02ab | 73.40 | 58.95 ± 3.10b | 71.50 | 54.92 ± 3.54a | 64.70 |
| Winter | 3 | 72.10 ± 1.15ab | 83.30 | 54.87 ± 1.84bc | 57.40 | 46.20 ± 1.85ac | 48.10 |
| Spring | 11 | 71.00 ± 1.99a | 73.30 | 67.53 ± 1.98b | 73.50 | 56.17 ± 2.49ab | 66.20 |
| Average | 29 | 71.58 ± 0.88 | 83.30 | 66.13 ± 1.52 | 74.40 | 56.55 ± 1.46 | 67.10 |

Note: Different letters (a, b, c) indicate significant differences ($p < 0.05$) among the three monitored zones for the respective season.

The cattle discomfort thresholds are between 90 and 100 dB, and physical ear damage occurs at levels of 110 dB [31]. In our study, such values were not reached even with the maximum reported values. In another study by Dimov et al. [7], maximum noise values in a milking parlor are 84.4 dB in spring. Beef breeds are less responsive to noise than dairy cattle breeds, and particularly Holsteins [32].

The reported by Weeks et al. [32] average noise level of 84 dB (from 75 to 90) for cattle building differs from the recorded by Algers [33] 61–73 dB. The noise environment in animal husbandry is due not only to equipment and mechanization, but also to the animals themselves (biological noise). The level of background noise (biological noise) from the biological manifestations of dairy cows varies from 72.7 to 83.8 dB [34].

Logically, the highest noise levels were reported in the milking parlor, with close seasonal averages, with little variation from 70.4 to 72.92 dB. It should be noted that the values in question were recorded at the beginning of milking, when the noise from

the milking installation was mainly taken into account. In the study by Dimov et al. [8], the noise values vary from 69.2 to 76.3 dB, in different seasons, which may be due to the different number of cows in the milking group during the study.

An increase in noise intensity is directly related to the number of animals on a cattle farm. A larger number of animals requires the use of more equipment for feeding and servicing the animals, for milking, and for cleaning the manure. According to a study by Deere [35], farms with a capacity of over 100 lactating cows use at least one tractor and one feed-distribution trailer. On average, farms with a capacity of 200 to 400 animals use 2–3 tractors and more than one feed-distribution trailer, and those with a capacity of over 600 animals use 4 tractors and 2 feed-distribution trailers. Based on these data, he concludes that the noise level increases with the increase in the capacity of the cattle farm. It has been established that the various motor vehicles used for distributing feed generate noise with an intensity of 74–108 dB. The fans used in various forced ventilation systems are a source of noise with a volume of 30 to 80 dB. Šistkova et al. [36] in their one-year study find an average noise level in a milking parlor of the same type (herringbone) of 69.2 dB and a maximum value of 82 dB. The average values in our study were higher than those reported by these authors, but the maximum values were almost the same. From the analysis of the variance of the controlled factors on the noise levels in the milking parlor, it was found that mainly the season had a statistically significant effect ($p < 0.01$) (**Table 2**).

**Table 2.** Analysis of variance for the influence of controlled factors on noise levels in the milking parlor.

| Sources of variation | Degrees of freedom (n−1) | Noise level (dB) | |
|---|---|---|---|
| | | MS | F P |
| Total for model | 7 | 43.73 | 2.43** |
| Season of reporting | 3 | 70.6 | 3.92** |
| Consecutive milking for the day | 2 | 40.4 | 2.25—n.s. |
| Consecutive reporting for the milking | 2 | 11.4 | 0.63—n.s. |
| Error | 79 | 18.0 | |

Note: **: significance at $p < 0.01$; n.s.: not significance.

Variations in noise levels for every milking of the day and during the milking itself were recorded. They had no significant effect. Dimov [37] also finds a significant effect of the season on levels of noise in livestock premises.

In **Figure 2**, LS-mean values and noise level variation (dB) by season and consecutive milking are presented. The highest noise mean values were reported during the winter season, especially during the midday and evening milking, 75–76 dB, with deviations above 80 dB. In another study of Dimov et al. [8], the highest noise levels are in spring—84.4 dB, which is probably due to the different number of cows in the herd during different seasons. The author reports average noise levels during the day in buildings for free-range dairy cows in the range of 52.5 to 83.0 dB. The author reports a significant effect of the season on noise level. Noise level is highest in the summer months, by 4–5 dB compared to the other seasons. During this season, in addition to the remaining noise from the service equipment, there is also noise from the fans for

cooling the premises. An increase in the noise level is reported at 4–6 pm in all three farms studied. This is related to the noise caused by the mechanization for placing the feed, as well as by the preparation for the start of milking. Although with small differences, a higher noise level is reported in buildings with a larger capacity and more frequent and more activities during the day, such as cleaning the premises, milking, and placing feed. Farms with higher capacity where management activities are performed more intensively—such as thrice-daily milking, routine cleaning, and the operation of numerous fans—the author reports elevated noise levels. Dimov et al. [7] found average noise levels in a milking parlor for one year to be 69 to 76 dB. Based on their analysis, the authors found that season was the primary factor exerting a statistically significant effect on noise levels. Variations in noise were also observed depending on the milking session during the day and during the milking process itself, although these effects were not significant. Another season with almost as high noise level values is the summer, with mean values of 72–74 dB.

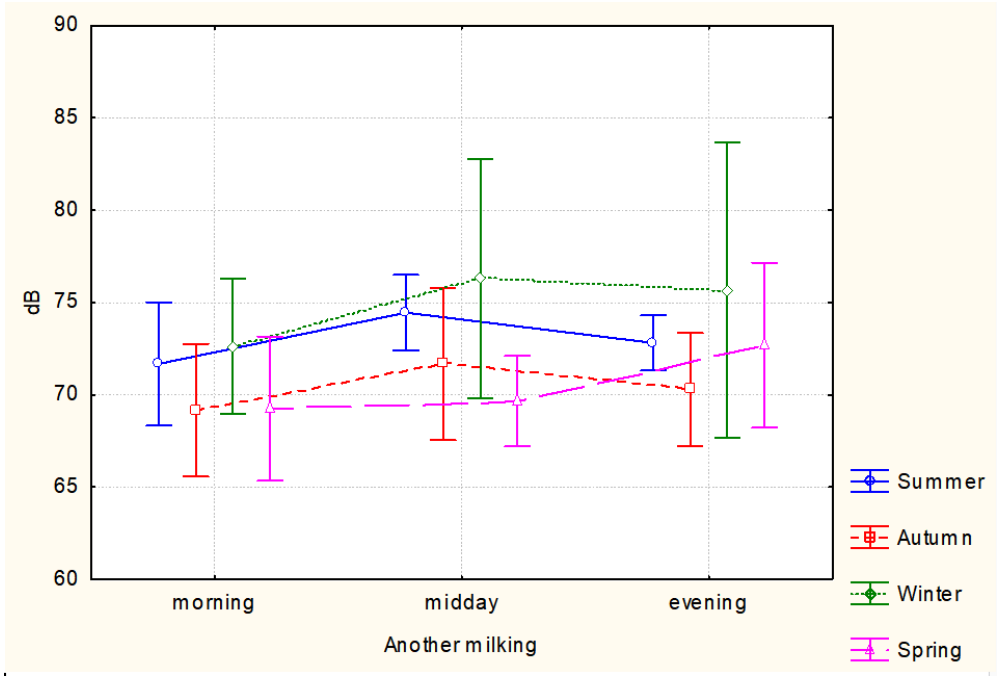


**Figure 2.** LS mean values and noise level variation by season and consecutive milking.

Although the background noise outside was at its lowest during the winter season, the highest noise levels were reported in the milking parlor. This was most likely due to the fact that the curtains of the building were down, the doors were closed, and there was no distraction of the noise originating from the production buildings.

During the milking process of dairy cows, the level of noise must not go beyond 65–70 dB, and if that happens, it should be only for a while, because this may cause medium-term health problems in humans and animals [23, 38]. According to this recommendation, in our research, in all seasons, there was an excess of these recommended values, especially in the summer and winter seasons. According to the definition of Dimov et al. [24], the noise level in the milking parlor can be rated as "moderate" at values of 71 to 75 dB. According to Ordinance No. 44 [39] of the Bulgarian legislation, the permissible noise level in the premises for raising cows is

75 dB (MZFF 2006). Relating our reported values to the thus given recommendation, only for the winter season, and only during midday and evening milking, there was an increase in the noise level above the stated recommendation.

The noise generated during the milking process depends on the technological equipment of the parlors, but the number of years in operation is also a factor. The total number of cows being milked simultaneously, hence the number of working milking units, also influences noise levels. The level of noise exposure is directly influenced by the way the operators work, speed in particular (quicker is noisier), precision of placement of teat cups (wrong performance of this action may lead to an irritating noise), operators communicating with each other, and also bringing the animals to the parlor [40]. Corrective actions related to reducing noise during milking include: regular replacement of pulsators and milking socks, from where noise most often comes from. Careful handling of the milking units from the udder after stopping the vacuum. Calm attitude of the milkers during the entire milking process.

Scientific sources show that noise in the environment of farm animals is a risk factor for their health. Especially long-lasting sound can affect the health of animals. Noise has a direct impact on reproductive physiology or energy consumption [7]. Gydax and Nosal [41] studied the effect of vibration and noise on the number of somatic cells in milk in 50 dairy farms. The number of somatic cells increases with increasing vibration intensity, but not with acoustic noise. After exceeding values above 90 dB, physiological processes in the animal body are usually disrupted. For example, disorders of the secretory activity of the adrenal cortex, adverse changes in the metabolism of polyunsaturated fatty acids and a decrease in the immune response, which in turn negatively affects the behavior of the animals (mainly feeding behavior) and in the case of dairy cows causes a decrease in milk yield, an increase in the number of somatic cells in milk and reproductive problems [42,43]. Human-produced sounds can also be stressful to farm animals. Loud shouting induces stress responses in farm animals [44]. Screaming is likely to be highly aversive to dairy cows [45]. Noise from people shouting and banging on metal doors and objects increases the heart rate and activity of cattle [22]. Lanier et al. [31] noted that cattle are more stressed by loud human shouting, especially when it is from a child. Many studies have shown that sudden novel sounds affect cattle behavior more than continuous loud noise [45]. Unexpected high-intensity noise, such as low-altitude aircraft (above 110 dB), can induce adverse behaviors in the milking parlor, such as kicking or pushing [24]. The threshold noise level expected to elicit a behavioral response from cattle is 85 to 90 dB [46]. Noise above this threshold elicits freezing or a strong startle response [24]. Pajor et al. [45] studied the responses of dairy cows to various manipulations. Exposure to noise increased restlessness and intolerant behaviors, leading to increased intervention by the handler.

## 4. Conclusion

In the study of the noise level in a milking parlor “fishbone” type, average values corresponding to moderately high levels were found, exceeding 65–70 dB, which would possibly worsen the welfare of dairy cows, as there were also reported maximum values

above the maximum permissible, especially for the winter season. It is recommended to optimize the technological processes in such a way as to reduce the noise level during milking as much as possible, which is undoubtedly important both for the operators (milkers) and for the comfort of the animals. In the current regulation regarding noise level norms in our country, related in particular to dairy cows, there are no specifics about noise levels in a milking parlor. It is necessary to supplement and update the current legislation regarding noise levels in animal husbandry.

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