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Features of goat behaviour depending on the temperature and humidity index

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Abstract. The temperature and humidity index (THI) is one of the most critical environmental factors, because it affects the body's thermoregulation and the overall productivity of goats. The study aimed to identify the relationship between the behavioural reactions of goats of different breeds and changes on the temperature and humidity index in the premises. The study used methods of time slices and recording of behavioural manifestations of goats. It was found that with a THI of 69-74%, the intensity of animal movement was high, but when the THI increased to 81%, activity sharply declined. After an extended stay in THI of 75-81%, goats find it quite challenging to restore average activity indicators. The animals were in the comfort zone (THI = 69-74%) and showed a moderate to weak approach to the feed table. With THI of 75-81%, goats showed interest; however, they did not consume feed. Animal rest positively correlates with such indicators as THI,

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$r =$ from +0.40 (Saanen) to +0.49 (Alpine); movement in the pen, $r =$ +0.62 and +0.66; approach to the feed table $r =$ +0.32 and +0.31; and urination $r =$ +0.16 and +0.12, respectively. A sharp increase in the rest frequency was detected at 76-81% THI. After normalising THI, animals also rested more frequently, which may be a consequence of heat stress. At the optimal level of THI (up to 74%), the frequency of goat rest decreased over a long period of time. A positive statistically insignificant correlation was established between THI and animal movement in the pen, $r =$ from +0.19 (Saanen) to +0.39 (Alpine). The movement of animals in the pen positively correlates with feed consumption, $r =$ from +0.30 (Saanen) to +0.34 (Alpine), and negatively with the rumination process in animals, $r =$ from -0.23 (Alpine) to -0.68 (Saanen). It was found that goats of the Saanen breed are more dependent on THI than the Alpine breed. The study's results should be considered when regulating the microclimate on premises for dairy goats and male goats

Keywords: ambient temperature; goats; animal behaviour; feed consumption; rumination

Introduction

Ukraine is currently developing goat breeding on a new, modern technical and technological basis, which, along with the development of other livestock sectors, is a key to filling the market with products and ensuring the country's food security. The success of modern industrial farms mainly depends on creating comfortable conditions for animals. By definition of V.V. Nedosekov *et al.* (2021), animal welfare is based on criteria such as feeding, environment, health, behaviour, and mental state. That is why the organisation of optimal conditions for keeping animals, in particular the microclimate – one of the most important factors of animal welfare – is important.

The welfare of animals kept in extensive conditions generally depends on the influence of climatic factors (heat, cold, humidity, etc.). Research conducted by I.A. Pomitun *et al.* (2021) confirms that long-term exposure to sub- and above-normal temperatures affects not only the behavioural responses of animals, but also affects the further development of animals and the manifestation of their reproductive ability. In particular, it was found that temperature stresses can affect the physiological processes and ability of animals to reproduce. For animals that are constantly kept indoors, air conditioning, optimal livestock density, the

type of floor and the availability of bedding are important factors of physical comfort. Insufficient ventilation, even at low ambient temperatures, can cause shortness of breath and stress, especially in pregnant animals. According to C.M. Dwyer (2022), when the livestock density is less than 1 m² per animal, their aggression and motor activity increase, as evidenced by competition for the best places to lie down. In specialised enterprises, the methods and systems of keeping are significantly changing, individual care for animals is decreasing, and the utilisation rate of technological machines and equipment is increasing. Therefore, according to R. Mylostyvyi & O. Chernenko (2019), A. Lykhach & V. Lykhach (2023), the technical environment requires a detailed study of the life manifestations of farm animals, including goats (Yıldırım *et al.*, 2019). This means that it is important to adapt technologies so that they consider the natural needs of animals and do not cause stress or inconvenience to them. Studies are conducted to find out what aspects of keeping affect the physiology, behaviour, and productivity of animals. G. Zobel *et al.* (2019) suggest that goats have acquired certain cognitive functions in the course of evolution. Goats have developed natural behaviours that affect how they feed and interact in the herd.

However, according to C.M. Dwyer (2022), in the context of intensive production technologies, goats are not able to independently meet their needs for providing sufficient feed and water, since they are completely dependent on humans. According to A.L. Goetsch *et al.* (2022), the eating behaviour of goats is determined by such important factors as indoor microclimate parameters, the level of animal productivity, the size of the technological group, the balance of the diet and the feeding regime. Animals, like humans, are capable of experiencing pain and suffering. Therefore, for example, the behaviour of goats during feed consumption may be an important marker for early detection of various diseases in them. Also relevant are studies on the relationship between the rank of dominance and feed consumption; features of herd behaviour and animal productivity. The study of these aspects helps to better understand the needs of animals and optimise their living conditions.

The temperature regime, as a factor of influence on animals, is one of the most critical, because it affects the thermoregulation of the body and the productivity of goats in general. In this regard, the purpose of the study – analyse the activity indicators of goats of different breeds and identify the relationship between behavioural responses of animals and changes in the temperature regime in the room.

Materials and Methods

The study was conducted in 2023 on the number of goats of Saanen (male goats, $n = 7$, females, $n = 14$) and Alpine (male goats, $n = 7$, females, $n = 14$) breeds in the conditions of the farming enterprise “Tetiana-2011” of the Kyiv Region. Among the goats that were simultaneously kept in the herd, analogue groups were formed, considering the age, live weight, and productivity of the animals (Table 1).

Table 1. Goat productivity indicators, $M \pm m$

| Group | Breed | Number of animals, units | Live weight, kg | Average daily milk yield, kg |
|-----------------|--------|--------------------------|-----------------|------------------------------|
| 1 – dairy goats | Saanen | 14 | 59.6 ± 0.42 | 2.63 ± 0.08 |
| 2 – dairy goats | Alpine | 14 | 59.9 ± 0.53 | 2.77 ± 0.12 |
| 3 – male goats | Saanen | 7 | 75.0 ± 0.44 | - |
| 4 – male goats | Alpine | 7 | 75.3 ± 0.36 | - |

Source: developed by the author

All animals were kept in the same stall conditions and fed the same type of feed. The diet included haylage of perennial grasses, hay, straw, and concentrated feed. Goats consumed feed from the feed table three times a day. Total nutritional value of the diet adjusted considering the energy requirements of lactation, based on 1 kg of goat milk (4% fat) – 5.2 MJ EE and 45-70 g DP.

Two methods were used to conduct the planned research.

The first was the time slice method (Danchuk *et al.*, 2020), observations were carried out three times a day, every 6 hours, for an hour. The behaviour of goats after milking and after feeding was recorded. Observations were

carried out for a month, with stable keeping of goats at different ambient temperatures. Hot weather changed for a period of prolonged rains with a cold snap. The average temperature in the room was $22.6 \pm 0.83^\circ\text{C}$ (min – 18, max – 30). Temperature and humidity index (THI) – 71.2 ± 0.88 (min – 67, max – 81). THI categories were defined by L.R. Hahn *et al.* (2009).

The second was a method for recording individual behavioural manifestations of goats (Danchuk *et al.*, 2020). During the observation, only cases of the necessary motor activity or behaviour of animals were recorded. The results obtained by this method did not allow judging the overall distribution of time by

different types of motor activity of animals, but they determined the frequency, duration, sequence, and direction of behavioural reactions of interest to the researcher. A system of abbreviations was used to collect data and record individual acts of goat behaviour. The following behavioural acts of goats were recorded: movement of animals along the pen – M, approach to the feed table – Af, feed consumption – F, rumination – Rm, rest – R, defecation – D, urination – U.

Considering abbreviated records of animal behavioural acts, the information was entered in the primary data processing protocol. The primary data was then processed and transferred to the final data processing protocol. Standing and lying down were taken as a state of rest; and any movement, searching for and consumption of feed, and fighting were taken as motor activity. Thus, by setting the number (+) and (-) during the follow-up period, the time spent on movement and rest was determined. The intensity of goat movement was calculated as the ratio between the rate of movement in the pen and the sum of animal activity indicators per day.

The mean values (M) for groups and their limits, the statistical error of the average (\pm m) and the value of correlation coefficients (r)

were determined as an indicator of assessing the relationship between goat behavioural responses and changes in the temperature regime in the premises. The bioethical requirements of the Law of Ukraine No. 3447-IV (2006) were followed during animal manipulations.

Results and Discussion

In the course of research, according to THI indicators, the following factors are considered: the following safety categories: optimal – up to 74%; preventive – 75-78%; dangerous – 79-83%; extremely dangerous – more than 84%. It was found that with a sharp increase in temperature, the intensity of goat movement decreased (Fig. 1). With a THI of 69-74%, the intensity of animal movement was high, but when the THI increased to 81%, there was a sharp decline in activity. It is worth noting that the goats reacted more stably to a gradual increase or decrease in temperature. They probably had some time to adapt to changing environmental conditions. When there were sudden changes in temperature, the activity of goats changed abruptly.

Normally, the movement intensity indicator should be 1, that is, an indicator of the movement of animals in the pen must be equal to the sum of all animal activity during observation.

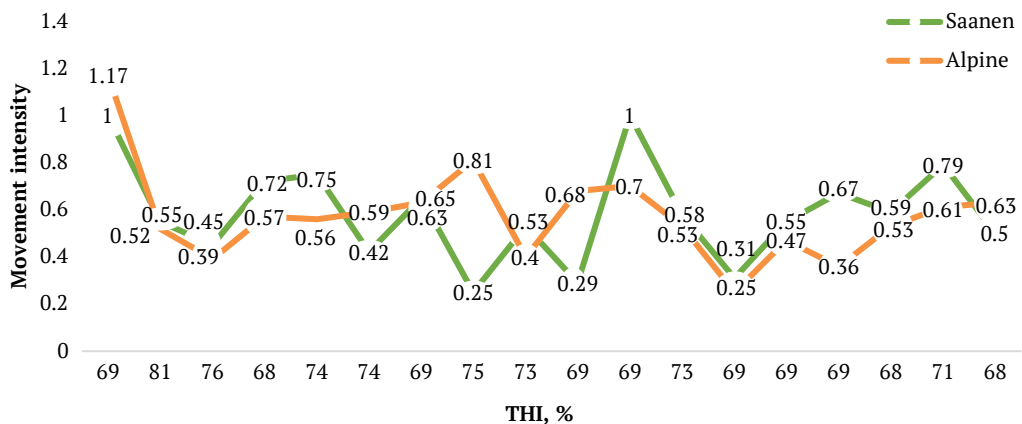


Figure 1. Movement intensity of all groups of animals, in accordance with the THI, %

Source: developed by the author

The approach to the feed table is not an indicator of feed consumption. This indicator was

recorded on the condition that the animal approached the feed table, but did not eat (Fig. 2).

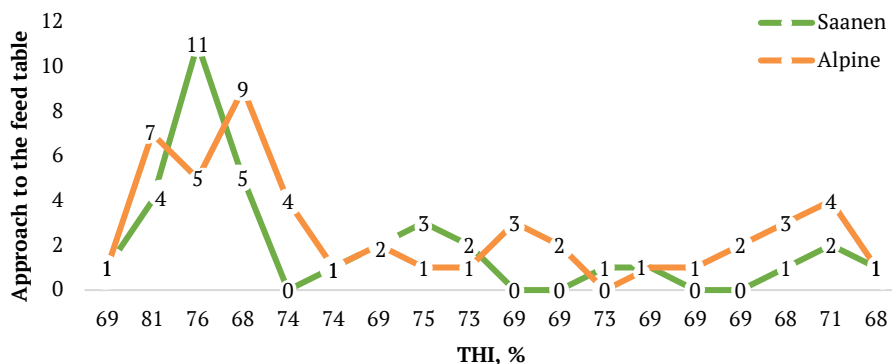


Figure 2. Approach to the feed table of all groups of animals, in accordance with THI, %
Source: developed by the author

Analysis of the data obtained shows that being in the comfort zone (THI = 69-74%) the animals showed a moderate to weak approach to the feeding table. However, during the period of a sharp increase in temperature, animals approached the feed table often. There was no definite correlation between feed consumption and the approach of animals to the feed table, depending on -0.09 (Alpine breed) to $+0.23$ (Saanen breed).

Observations have shown that at THI 75-81% (warning / dangerous), goats showed interest however, there was no feed consumption.

The animals either stood for a certain time near the feed table, or sniffed the feed and left. These approaches were repeated every 10-15 minutes. This indicates that animals cannot focus only on their feed intake and often change their activities. This behaviour can also indicate the quality of feed. In any case, the animals felt uncomfortable. At THI up to 74%, less amount of "idle" approaches to the feed table was recorded. The data show a more stable behaviour of Alpine goats compared to Saanen goats (Fig. 3). It was recorded that the animals approached the feed table exclusively to consume feed.

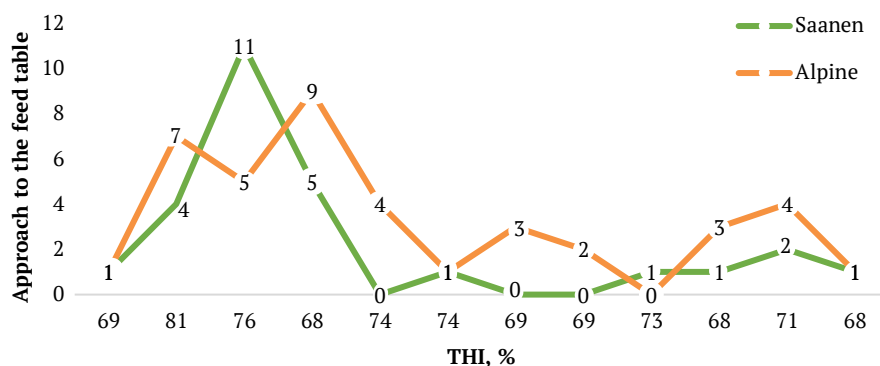


Figure 3. Approach to the feed table of dairy goats, according to THI, %
Source: developed by the author

Male goats showed a similar response to temperature rise, but it should be noted that it was less intense than goats (Fig. 4). The graph shows the difference in response to the

stimulus between the breeds under study. Saanen male goats sharply increased the activity of the approach to the feed table, while Alpine male goats, on the contrary, reduced it.

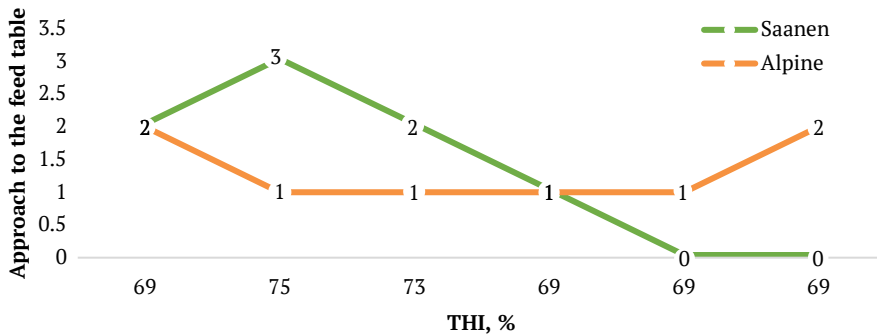


Figure 4. Approach to the feed table of groups of male goats, according to THI, %
Source: developed by the author

As noted by R.M. Reshma Nair *et al.* (2021), under stress, animals reduce metabolic activity, in particular rumen activity. Thus, it is predicted that at high THI values, the experimental animals will chew less time, delaying this process for the night, or a cooler period, when the ambient temperature will be optimal and comfortable for maintaining the normal functioning of their digestive system. That is why the frequency

of feed consumption indicator is important when evaluating the behaviour of goats at different temperatures.

Observation data (Fig. 5) confirm the results obtained by R.M. Reshma Nair *et al.* (2021). Goats consumed food often and for a short period of time precisely because of the elevated THI. This conclusion was made based on the results of the analysis of the data shown in Fig. 2 and Fig. 5.

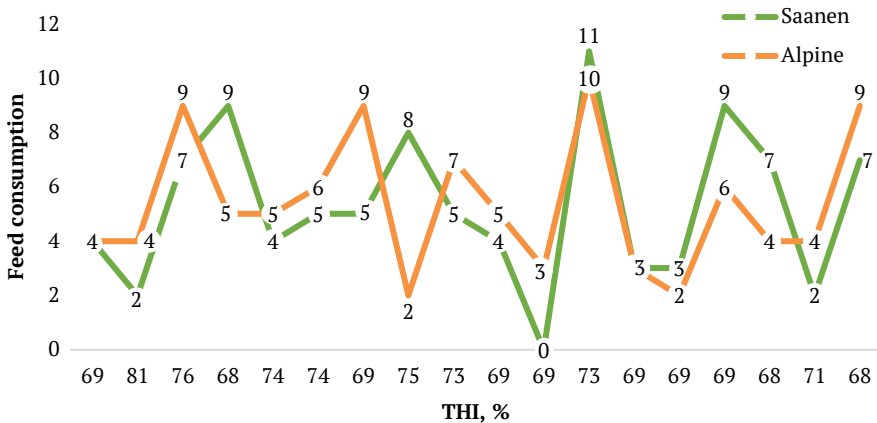


Figure 5. Feed consumption of all experimental groups of animals, according to THI, %
Source: developed by the author

In the course of the study, it was revealed such pattern: when THI 76-81%, both the maximum approaches to the feed table without feed consumption and the maximum frequency of feed consumption were simultaneously observed in animals. That is, the animals quickly changed their activities, moved a lot, and generally spent less time consuming feed than, for example, at normal temperatures, when the frequency of approach to the feed table was the

lowest, and the frequency of feed consumption was the highest. Thus, it can be concluded that at THI of 69-73%, the animals approached the feed table exclusively for feed consumption and stayed there for a longer time.

Analysing the data in Fig. 6, it is worth noting that no significant difference was found between the breeds. Saanen and Alpine goats showed almost identical trends in feed consumption depending on the changes in THI.

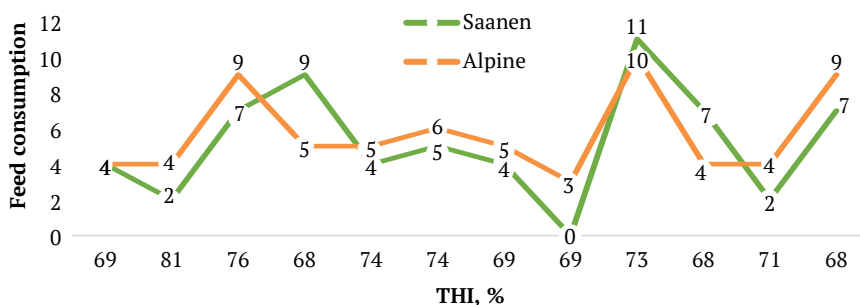


Figure 6. Feed consumption of groups of dairy goats, according to THI, %

Source: developed by the author

However, unlike dairy goats, male goats (Fig. 7), observed a significant difference in the response to THI of 75% (warning). Saanen male goats had an increased frequency of feed

consumption, while Alpine male goats had a significant decrease. A minor and statistically insignificant correlation was established between THI and animal feed consumption ($r = +0.06$).

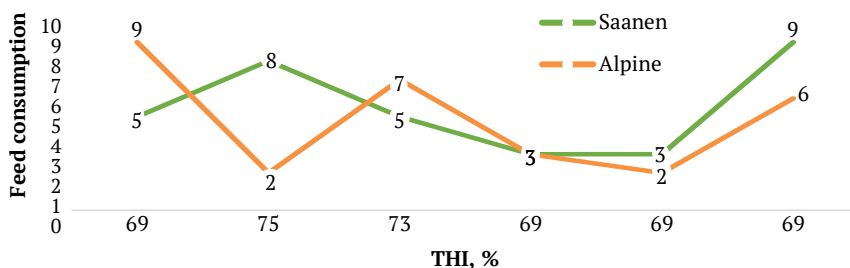


Figure 7. Feed consumption of goat groups, according to THI, %

Source: developed by the author

Given the features of ethological studies, the main object of which is live animals, it is quite difficult to predict their activity during the experiment. Notably, the act of defecation in animals occurred at optimal THI values (69-74%). A low and insignificant correlation was

established between THI and the frequency of defecation ($r = +0.21$).

A small positive statistically insignificant correlation was found between THI and urination in goats. For the entire goat population under study, the correlation coefficient was $+0.08$.

There was also no correlation between the approach to the feed table and urination – from -0.19 (Saanen breed) to +0.35 (Alpine breed); between feed consumption and urination – from -0.07 (Alpine breed) to +0.21 (Saanen breed).

At THI of 81%, a decrease in the frequency of chewing in animals was detected (Fig. 8), while goats showed relative calmness. At THI of 68-75%, high rates of rumination were recorded. Although THI of 75 % is considered a warning category for animals, according to

the observations, it did not have a significant effect on the reduction of rumination frequency. However, at THI of 76%, a sharp decrease in the rumen activity was observed. The correlation coefficients between THI and rumination were found to be low and statistically insignificant, ranging from -0.16 (Alpine breed) to +0.07 (Saanen breed). In addition, all the animals abruptly reacted to the change in THI. This may indicate a rather low recovery rate after heat shock.

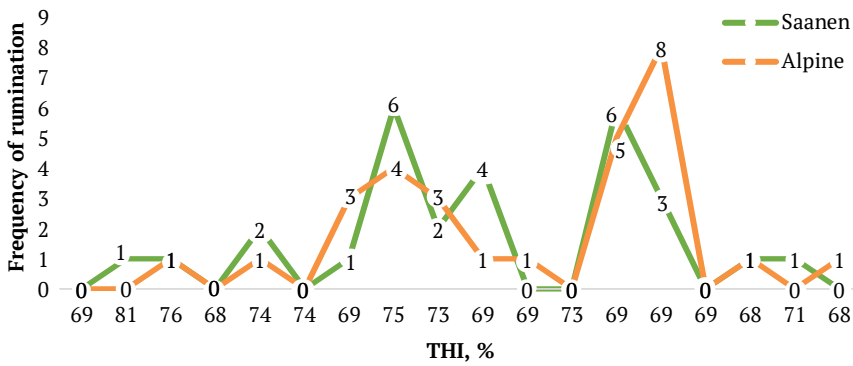


Figure 8. Frequency of rumination in all animal groups, according to THI, %
Source: developed by the author

Goats of the studied breeds reacted almost equally to changes in THI, however, there were some differences (Fig. 9). The reaction of Saanen goats was more intense and coincided

with temperature changes compared to Alpine goats. Overall, Alpine goats were quite passive in responding to changes THI and in general, they had low rumen activity.

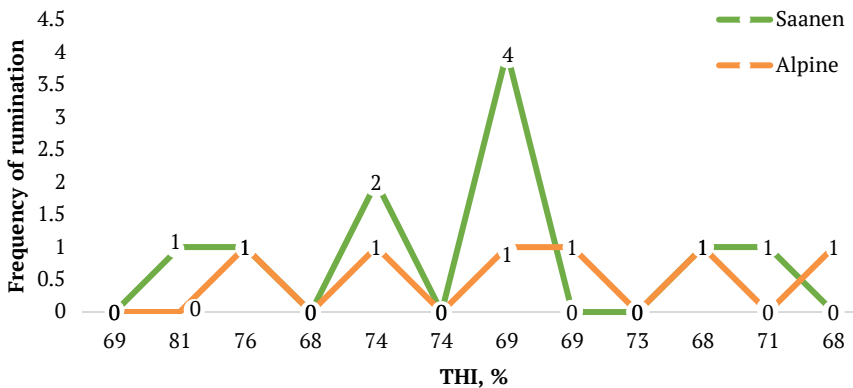


Figure 9. Frequency of rumination in dairy goats, according to THI, %
Source: developed by the author

There was no significant difference between the frequency of rumination in male goats of both breeds (Fig. 10). The only significant difference was observed at THI of 69%,

when male goats of the Saanen breed showed an average level of rumination frequency, and in male goats of the Alpine breed it increased sharply.

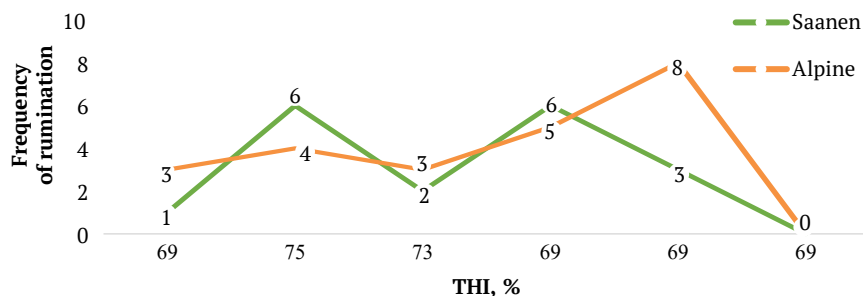


Figure 10. Frequency of rumination in male goats, according to THI, %

Source: developed by the author

Rest of animals is an important indicator of their overall comfortable condition. When animals often change their position, they cannot relax – this indicates the presence of discomfort. Rest positively correlated with such indicators as THI, $r =$ from +0.40 (Saanen) to +0.49 (Alpine); movement in the pen, $r =$ +0.62 and +0.66; approach to the feed table, $r =$ +0.32 and +0.31 and urination, $r =$ +0.16 and +0.12, respectively. That is, with all the parameters associated with animal movement. When the animal is uncomfortable lying down, it moves to another place in search of a more comfortable one. Therefore, it is necessary to analyse

the frequency of rest only considering the indicators of the frequency of movement in the pen. It was predicted that in a state of discomfort, with high THI indicators, animals will have a simultaneous increase in both the activity of movement in the pen and the frequency of rest.

Studies have revealed a sharp increase in the frequency of rest at THI of 76-81% (Fig. 11). After normalisation of temperature, there was also an increased frequency of rest in animals, which may be a consequence of heat stress. Then, over a long period of time, at the optimal THI (up to 74%), the frequency of animal rest decreased.

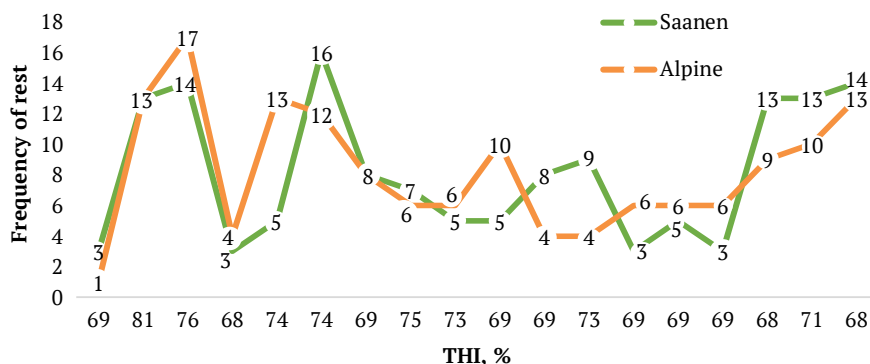


Figure 11. Frequency of rest of all animal groups, according to THI, %

Source: developed by the author

However, it is not possible to definitively confirm the effect of temperature on the increase in the frequency of rest based on the data obtained. At the end of the observations, a similar peak of activity was detected, but at the optimal temperature (THI of 68-71%). Therefore, for a more accurate assessment of the impact of this index on animal rest, it is necessary to extend the duration of experiments to have a greater volume of data. A positive statistically insignificant correlation was established between THI and animal movement in the pen, $r =$ from +0.19 (Saanen) to +0.39 (Alpine). The movement of animals in the pen positively correlated with feed consumption, $r =$ from +0.30 (Saanen) to +0.34 (Alpine) and negatively with rumination, $r =$ from -0.23 (Alpine) to -0.68 (Saanen). The movement of animals in the pen is the main indicator of their activity. The movement of animals is an important parameter of their comfortable state and normally occurs constantly with

breaks for food consumption, rest, etc. Therefore, to determine the state of discomfort of animals, it is advisable to describe it together with an indicator of the opposite activity of animals, namely, rest.

As already noted, sharp changes in the activity of animals were recorded during the observations. The goats took a recumbent position to rest, but after a short time (from 3 to 5 minutes) they got up and changed their place to lie down. This phenomenon was repeated. This frequency of position changes may indicate discomfort in animals, they are not able to relax and rest. Quite often, in the process of finding the best place to rest, animals showed aggression and struggle for places to lie down, especially near drinkers and walls. It was found that animals of the studied breeds reacted differently to the change in THI (Fig. 12). Animals of the Saanen breed demonstrated more rapid changes in the frequency of movement in the pen, unlike Alpine breed.

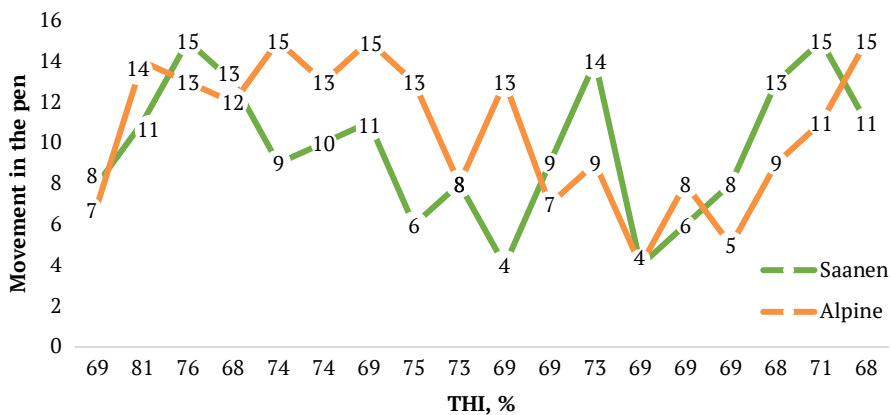


Figure 12. Frequency of movement in the pen of all groups of animals, according to THI, %
Source: developed by the author

However, it is not possible to highlight the dependence of animal movement in the pen and THI indicators, this pattern is not observed on the graph. It was suggested that at high values of THI, both indicators (movement in the pen and rest) will have equally high

activity indicators. Comparing graphs of these indicators (Fig. 11, 12), in general, identical peaks at THI 75-81 % can be distinguished. Subsequently, when the temperature regime was normalised, the separation of the values of these parameters was observed. The level of

rest of animals decreased simultaneously with a decrease in the activity of movement of animals in the pen (Saanen breed) and there was a decrease in the frequency of rest with high indicators of movement in the pen (Alpine breed). Thus, it can be assumed that animals of Saanen breeds are more dependent on temperature and respond to an increase in THI – by increasing the activity and frequency of position changes, and on normalisation of THI – by general calming (extending the rest time and reducing movement in the pen).

The study analysed the activity indicators of goats of different breeds depending on changes in the room temperature regime. The negative impact of high temperature on animal productivity was observed during the introduction of farm animals from temperate climates to warm climates and during the first attempts to increase the milk productivity of animals in subtropical regions (Berman, 2012). Exploring the problems of global warming, M. Cheng *et al.* (2022) concluded that extreme climate change has a negative impact on the rate of increase in livestock population, their productivity, reproductive function, morbidity, and mortality.

According to S.B. Romo-Barron *et al.* (2019), the thermal effect on sheep productivity and well-being is most noticeable when the air temperature decreases below 12°C (lower threshold) or increases above 25-31°C (upper threshold), when the thermoregulation mechanisms significantly deviate from the norm. Behavioural responses to heat stress in sheep are manifested, depending on its severity and duration, by a permanent or temporary decrease in motor activity and by seeking shaded areas. According to I.A. Pomitun *et al.* (2021), the optimal air temperature on the day of insemination of ewes (13-26°C) contributed to the emergence of polioovulation and better fertilisation of eggs, as evidenced by the output of lambs born as part of twins and triplets and a 7.3% higher multiplicity of ewes against animals whose insemination occurred at elevated temperatures.

Research W.H.E.J. van Wettere *et al.* (2021), conducted using ecological Chambers, proved the negative effect of high temperatures ($\geq 32^\circ\text{C}$) on the components of sheep fertility (estrus, fertilisation, embryo survival, and lambing). The influence of the above temperatures is especially noticeable 5 days before and 5 days after estrus. Heat stress for 5 days before estrus reduces the fertilisation rate by almost 60%. It was also found that prolonged exposure to high temperatures (32-41°C) during pregnancy of sheep reduces the weight of lambs at birth, their viability, thus increasing neonatal mortality.

Environmental parameters and physiological responses of animals are the starting point for mathematical modelling of their impact on animal development and manifestation of their productivity. R. Mylostyvyi & O. Chernenko (2019), investigated the relationship between the parameters of the thermal environment and the milk productivity of cows in the hot period. The integral indicators of the cowshed's microclimate state were the temperature and humidity index (THI) and the temperature and humidity index in the cowshed hangar type (THI_{CHT}). The researchers found a weak correlation between sun exposure and daily milk yield at $r = -0.2$, between relative humidity and daily milk yield at $r = +0.4$, and between relative humidity and milk fat content at $r = +0.2$. The correlation between daily milk yield, milk fat, milk protein content and, wind strength $r = -0.2$ to 0.4. Between daily milk yield, milk fat and milk protein content, and air temperature $r = -0.2$ to 0.5 ($p < 0.05$).

As noted by R.M. Reshma Nair *et al.* (2021), domestic goats are an ideal subject for climate change research. Anatomical, physiological, and behavioural features of goats help them adapt to different environmental conditions. According to N. Koluman (2023), during periods of drinking water scarcity, goats voluntarily reduce their dry food intake. R.M. Reshma Nair *et al.* (2021) report that when exposed to high temperatures, goats are able to concentrate urine, thus maintaining the body's water

balance. In turn, N. Maksimović *et al.* (2023) found that the heart rate in goats with limited access to water decreases, further slowing down the metabolic rate to conserve water and compensate for the reduction in animal food intake.

However, according to S. Hamzaoui *et al.* (2013), goats are not heat-resistant during lactation. They show certain changes in productivity due to heat stress, namely, a decrease in milk yield and a change in the chemical composition of milk. However, there is also a decrease in feed consumption. In goats, the maximum appetite was shown at the ambient temperature range from 0°C to +10°C, then it was gradually lost when the temperature rose to +40°C. Under heat stress, goats' rectal temperature (+0.58°C), respiratory rate (+48 breaths/min), water consumption (+77%), and water evaporation (+207%) increased.

A.A.K. Salama *et al.* (2020) also confirm that heat stress causes noticeable changes in thermophysiological properties in dairy goats, including an increase in rectal temperature and respiratory rate, along with a decrease in feed intake (by 28%) and milk yield (by 21%). In turn, A. Contreras-Jodar *et al.* (2018) found that heat stress not only negatively affected the milk production levels of Murciano-Granadina goats and their eating behaviour, but also led to changes in the immune system and increased susceptibility to diseases. Using the THI index, a decrease in feed intake (by 29.8%), milk yield (by 8%), protein content (12%) and fat content (13%) in milk was found in goats exposed to heat stress.

HA. Yamani & N. Koluman (2020), investigated how rising ambient temperatures affect milk production in Saanen, Alpine, and Boer goats. According to their data, milk yield in goats decreased with an increase in the value of THI. Overall, THI was 70.097% in the spring season and 82.65% in the summer season. It is recorded that for every 1 unit of increase in THI, there is a decrease in milk yield by 1%. THI values of 75-78% cause stress, and THI values of 70% or less are comfortable for animals.

S.V. Chumak *et al.* (2021) found that the presence of Saanen goats under THI conditions of more than 65% affected some chemical indicators of goat's milk. In particular, there was a decrease in fat content by 29%. There were no differences in protein and lactose concentrations. A decrease in the fat/protein ratio in goat's milk by 27% and dry matter by 9% was observed during the month. The concentration of urea nitrogen in milk decreased by 60%. There was a significant increase in the number of somatic cells almost three times, which confirms the presence of a stress response from the mammary gland.

Sharp fluctuations in the intensity of movement of animals are always a signal of violation of their comfortable conditions, which is confirmed by observations of M. Yıldırım *et al.* (2019) and research data. Animals become restless, constantly move, aggression increases, or vice versa, they become passive. The hierarchy of goats in the herd also affects their behaviour and feed intake ($p \leq 0.005$). Low-ranking goats have a higher feeding frequency ($P < 0.001$). The duration of rest (lying down and standing) decreases in goats of medium- and low-rank ($P = 0.001$). Competitive behaviour increases ($P = 0.001$) in medium- and low-rank goats.

Summarising the results of this study, it should be noted that with a sharp increase in temperature, the intensity of movement of Saanen and Alpine breeds decreased. With THI indicators of 69-74%, the intensity of animal movement was high, but with an increase to 81%, there was a sharp decline in activity. It was also found that after a long stay in THI conditions, 75-81% of goats find it quite difficult to restore normal activity indicators.

Thus, the analysis of scientific sources and the present research indicate that THI is a good indicator of detecting heat stress in animals. Therefore, it is advisable to consider this indicator when regulating the microclimate in premises for dairy goats.

Conclusions

It was found that at THI values of 69-74%, the intensity of animal movement was high. When increasing THI up to 81%, there was a sharp decline in activity. After a long stay in THI of 75-81%, animals had significant difficulty in restoring normal activity levels. Being in the comfort zone (THI = 69-74%) the animals showed a moderate to weak approach to the feed table. At THI of 75-81% (warning / dangerous), goats showed interest however, there was no feed consumption. There was no definite correlation between feed consumption and the approach of animals to the feed table, depending on -0.09 (Alpine breed) to +0.23 (Saanen breed).

At THI of 69-73%, animals approached the feed table exclusively for feed consumption and stayed there for a longer time. At THI of 76-81%, animals simultaneously showed both the maximum approaches to the feed table without feed consumption and the maximum frequency of feed consumption. A minor and statistically insignificant correlation was established between THI and animal feed consumption ($r = +0.06$). A small positive statistically insignificant correlation was found between THI and urination in goats ($r = +0.08$). No correlation was found between the approach to the feed table and urination – from -0.19 (Saanen breed) to +0.35 (Alpine breed); between feed consumption and urination – from -0.07 (Alpine breed) to +0.21 (Saanen breed).

A decrease in the frequency of rumination was found in animals at THI of 81%, while goats exhibited relative calmness. At THI of 68-75%, high rates of rumination were recorded. At THI of 76%, a sharp decrease in the rumen activity was observed. Low statistically insignificant correlation coefficients were found between THI and ruminant performance in animals, ranging from -0.16 (Alpine breed) to +0.07

(Saanen breed). Rest was positively correlated with such indicators as THI, $r =$ from +0.40 (Saanen) to +0.49 (Alpine); movement in the pen, $r = +0.62$ and +0.66; approach to the feed table $r = +0.32$ and +0.31, and urination $r = +0.16$ and +0.12, respectively.

A sharp increase in the frequency of rest was detected at THI of 76-81 %. After normalisation of temperature, an increase in the frequency of rest in animals was also observed, which may be a consequence of heat stress. At the optimal level of THI (up to 74%), over a long period of time, the frequency of goat rest decreased. A positive statistically insignificant correlation was established between THI and animal movement in the pen, $r =$ from +0.19 (Saanen) to + 0.39 (Alpine). The movement of animals in the pen positively correlates with feed consumption, $r =$ from +0.30 (Saanen) to +0.34 (Alpine), and negatively with the rumination process in animals, $r =$ from -0.23 (Alpine) to -0.68 (Saanen). It was found that animals of the Saanen breed in the conditions of the farm “Tetiana-2011” were more temperature-dependent and responded to an increase in THI by increasing activity and frequency of position changes, and to the normalisation of THI – by general calmness (lengthening of rest time and reduction of movement in the pen). In order to better understand the algorithm of behaviour of dairy goats under intensive technology, it is advisable to conduct similar studies in the future, subject to an increase in the number of experimental animals and the duration of observation.

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Conflict of Interest

None.

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Особливості поведінки кіз залежно від температурно-вологісного індексу

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Анотація. Температурно-вологісний індекс (ТНІ) є одним з найбільш критичних факторів середовища, адже впливає на терморегуляцію організму та продуктивність кіз в цілому. Мета дослідження – виявити взаємозв'язок між поведінковими реакціями кіз різних порід зі зміною температурно-вологісного індексу у приміщенні. У дослідженні використано методи часових зрізів і реєстрації поведінкових проявів кіз. Виявлено, що за показників ТНІ 69-74 % інтенсивність руху тварин була високою, однак при підвищенні ТНІ до 81 %, відбувався різкий спад активності. Після тривалого перебування в умовах ТНІ 75-81 % козам досить важко відновлювати нормальні показники активності. Перебуваючи у зоні комфорту (ТНІ = 69-74 %) тварини демонстрували помірний та слабкий підхід до кормового столу. При ТНІ 75-81 % кози проявляли інтерес до кормового столу, однак споживання корму не відбувалося. Відпочинок тварин позитивно корелює з такими показниками як ТНІ, $r =$ від +0,40 (Зааненські) до +0,49 (Альпійські); рух по загону, $r =$ +0,62 і +0,66; підхід до кормового столу $r =$ +0,32 і +0,31 та сечовипускання $r =$ +0,16 і +0,12 відповідно. Виявлено різке підвищення частоти відпочинку при ТНІ 76-81 %. Після нормалізації ТНІ також спостерігали підвищену частоту відпочинку у тварин, що може бути наслідком теплового стресу. За оптимального ТНІ (до 74 %), упродовж тривалого періоду, частота відпочинку кіз зменшувалася. Встановлено позитивну статистично недостовірну кореляцію між ТНІ та рухом тварин по загону, $r =$ від +0,19 (зааненські) до +0,39 (альпійські). Рух тварин по загону позитивно корелює із споживанням корму, $r =$ від +0,30 (Зааненські) до +0,34 (Альпійські) та негативно з жуйним процесом у тварин, $r =$ від -0,23 (Альпійські) до -0,68 (Зааненські). Виявлено, що кози Зааненської породи більш залежні від ТНІ ніж Альпійської. Результати дослідження доцільно враховувати під час регулювання мікроклімату в приміщеннях для дійних кіз і цапів

Ключові слова: температура навколишнього середовища; цапи; поведінка тварин; споживання корму; румінація