# CONDITION OF THE DYNAMIC HOMEOSTASIS AT COWS RAISED IN TWO TYPES OF BUILDINGS

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**Abstract:** A study has been conducted for the condition of the dynamic homeostasis at cows, Bulgarian black and colored cattle race. They have been bred, tied up, in two types of buildings during the summer. For this purpose, there have been used the physiological indicators: pulse and breathing frequency, body and skin temperature and ruminal movements. The following indexes have been applied: Tom`s index – for ambience evaluation; Dmitriev`s index – for adapting; Benezra`s and Rauschenbach - Erokhin`s – for temperature stability.

It has been established that Tom`s index for both buildings varies between 66, 2 and 68, 3, at optimum values of 45 – 55. During the summer, body and skin temperatures of cows from both sheds vary within the range of the physiological rate. Skin temperature depends weakly on the building temperature (r = 0,195 and r = 0,192). The skin temperature depends moderately on the temperature (r = 0,327 and r = 0,335) and the relative moisture of the shed`s ambience (r = 0,388 and r = 0,397).

Pulse and breathing frequency have positive high casual dependence on the temperature maintained in the buildings (r = 0,698 and r = 0,712) and (r = 0,585 and r =0,569). Breathing frequency is in a high negative correlation with the relative moisture (r = - 0,716 and r = - 0,731).

Bulgarian black and colored cattle race, raised in two types of buildings during the summer, demonstrate good dynamic homeostasis.

**Keywords:** cattle, shed ambience, interior indicators, homeostasis.

# СЪСТОЯНИЕ НА ДИНАМИЧНАТА ХОМЕОСТАЗА ПРИ КРАВИ ОТГЛЕЖДАНИ В ДВА ТИПА СГРАДИ

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**Резюме:** Изследвано е състоянието на динамичната хомеостаза при крави от порода Българско черно-шарено говедо, отглеждани вързано в два типа сгради през летен период. За целта са използвани физиологичните показатели честота на пулса и дишането, телесна и кожна температура и руменови движения. Приложени са и индексите на: Тоm за оценка на средата; Дмитриев за адаптивност; Benezra и Раушенбах – Ерохин за температурна устойчивост.

Установено е, че индексът на Тоm се колебае между 66,2 и 68,3 за двете сгради при оптимални стойности 45 – 55. Телесната и кожната температури при кравите от двата типа обори през лятото се колебаят в рамките на физиологичната норма. Телесната температура е слабо зависима от температурата на сградите (r = 0,195 и r = 0,192), но кожната им температура е в умерена зависимост от температурата (r = 0,327 r = 0,335) и относителната влажност на оборната среда (r = 0,388 r = 0,397).

Пулсовата и дихателната честота показаха положителна, висока причинна зависимост от температурата, поддържана в сградите (r = 0,698 и r = 0,712) и (r = 0,585 и r =0,569), но спрямо относителната влажност дихателната честота е във висока, отрицателна корелативна връзка (r = - 0,716 и r = - 0,731).

Кравите от породата Българско черно-шарено говедо, отглеждани в двата типа сгради през лятото, демонстрират добра динамична хомеостаза.

**Ключови думи:** говеда, оборна среда, интериорни показатели, хомеостаза.

## INTRODUCTION

Dynamics of ambience factors (temperature, moisture, sunshine, etc.) is a reason for change of the different physiological indicators at animals: body temperature and breathing (Selem et Adam, 1988; Rayak and Tveritin, 1983); metabolism (Bianca, 1959) and mineral exchange. As a result, the forage consumption is reduced, the rumen motor activity is changed (Morrison, 1983), the organism stability is affected (Hristev, 2007; Stefanova, Iliev, 2005), the productivity, etc.

Each of these indicators is used to characterize a particular system condition. Together they represent the animal interior (Evtimov and Konstantinov, 1968). Due to their easiness and objectiveness, the indicators are preferred by many researchers for the evaluation of adapting possibilities at all animals, including the cattle (Du Prees, 2000).

The variety of ambience factors leads to a necessity of examination of their influence on the organism condition. Changes of physiological parameters can be earliest signals for the influence of the outer stress factors.

As an integral value, the building temperature is dependent on the temperature of the inner surface of the building`s ambient elements. The regulated difference between the inner temperature and the temperature of the inner surface of walls is 30C. Moisture dynamics in the buildings does not allow maintaining this difference (Enimaev, Andonov, 2000).

Optimum temperatures for cattle in the summer are 10-150C, with variations from 5 to 280C (Regulation № 44). Spasov and group (1975) present opinions of different authors for the period of 50 years – from 1924 to 1973. Most of them point out optimum temperatures from 5 (10) to 150C, and for maximum - from 20 to 250C.

The aim of the present development is to establish the level of the dynamic homeostasis at cows, raised tied up, in two types of buildings, in the summer. Several interior indicators and formulas have been used.

**MATERIALS AND METHODS**

Two types of buildings have been examined, each of them for 40 cows, Bulgarian black and colored cattle race, raised tied up. The buildings are made of metal supporting structure. The animals in both buildings are fed with same forages, served by tractors.

The metal supporting structure (walls and roof) of the first building is made of panels, Europanel type, 10 cm thick. The building has the following measurements: 12 m width, 4, 50 m height. The boxes are in two rows along the central passageway, 3 m wide. The passageway is also a feeding trough. The boxes` measurements are 170 cm to 130 cm. The manure ditch is 40 cm wide. It is covered with grating and it passes to a service passageway, 2, 80 m wide.

There is natural ventilation that is carried out by 8 wall and 30 roof windows with a total size of 42,6 m2. The velocity of air movement is from 0,5 to 1,2 m/s. Light intensity from the light coefficient is 1:9. Artificial light is 22 lux/m2 and is carried out by 15 pairs of neon tubes, each with power of 40 W.

Water troughs are used for the cattle, placed in the front part of every two neighbor boxes. The manure is cleaned manual, and the milking is performed with milk-cans.

The metal construction of the second building is encircled with galvanized sheet iron. There is two-meter space between the animals and the roof construction, except the space above the central passageway, which is filled with straw bales. They play role of a heat-insulating and hydroscopic material. The ventilation is carried out only by the windows and doors. The building measurements are 30/12/5 m. The boxes are in two rows on the longitudinal axis. Each box has measurements 170/120 cm. After the boxes there are manure gutters and maintaining passageway, 2 m wide. Food is set in a cement feeding troughs, 75 cm wide. The milking is performed with the help of a central dairy-main. Drinking water is provided in cup water troughs placed between every two neighbor boxes.

The temperature and the relative air moisture in and out of the building are measured three times with the psychro-meter of Asman. The hygienic evaluation of the temperature-moisture regime and the building air exchange are conducted according to the received methods in the zoo-hygiene (Netsov, Stoyanchev, 1999).

For ambience evaluation we have used Tom`s index (1959) for evaluation of temperature and relative air moisture: index of temperature and moisture (ITM) = 0,8 x t0 + (H/100) x (t0 + 14,4) + 46,4, where t0 is the building temperature, 0C, H – the relative moisture in the building, %. The breathing and pulse frequency, the rectal temperature and the rumen movements have been recorded according to the received methods and sources of the propaedeutics (Ibrishimov, Lalov, 1984).

Except the inner indicators, for evaluation of cows` adaptability we have also used:

Dmitriev`s coefficient for adaptability: КА = Тд/Тс + Дд/Д, where Тд is day, and Тс - morning body temperature; Дд - day и Дс –morning breathing frequency.

Index for temperature stability of Rauschenbach and Erokhin (1975): index of temperature stability (ITS) =2(к.t2-10.dt+30), where k is a coefficient of regression (in this case 0,6), t2-ambience temperature и dt-difference between the highest (day) and the lowest (morning) body temperature.

Index for temperature stability of Benezra (1954): I = T/38,3 + D/23,where T is the body temperature, and D –

breathing frequency.

The received results have been processed by the methods of variation statistics.

## RESULTS AND DISCUSSION

Data in Table 1 show that in both buildings there is a temperature-moisture regime during the summer with high temperature and relative moisture. This is also proved by Tom`s index (1959), which varies between 66, 2 and 68, 3 for both buildings. To maintain the optimum temperature from 8 to 150C its values should be between 45 and 55. According to Berman (2005), the recommended optimum temperatures should be 5-250C. In this case, the examined cows are in stress conditions.

Table 1

**Average month temperatures and relative moisture in and out the building**

| Month | Temperature, 0C | | | Relative moisture, % | | |
|---|---|---|---|---|---|---|
| | outside | inside | | outside | inside | |
| | | 1 | 2 | | 1 | 2 |
| June | 19,5 | 24,8 | 21,5 | 73 | 82 | 80 |
| July | 22,4 | 26 | 24 | 68 | 81,5 | 79,8 |
| August | 20,2 | 28 | 25 | 79 | 86 | 81 |
| September | 18,6 | 25 | 22 | 67 | 83 | 79 |

**Notice:** Building 1 – with „Euro-panel"
2 – with sheet iron

For maintaining the optimum temperature and moisture in the buildings, there should be fresh air in capacity of 1 148 m3/h for each animal, total 45 900 m3/h. If we express this capacity through the intensity (rate frequency) of the air exchange, it means that the change from worked air to fresh air must be done after 24 and 26 revolutions per hour for the first and the second buildings, respectively. Premises temperature depends on the outer temperature (r = 0,586 and r = 0,581). Inner temperature and relative moisture also show high, but negative dependence (r = - 0,572 and r = -0,588).

The formed temperature-moisture regime has effect on the examined physiological indicators (Table 2). The inner body temperature varies, but remains within the borders of the physiological norm (Petkov and others, 2000). The norm depends slightly on the ambience temperature (r = 0,195 и r = 0,192). It depends slightly, but negatively, on the relative air moisture (r = - 0,248 и r = - 0,260).

Skin temperature is in moderate causative dependence on the temperature (r = 0,327 r = 0,335) and on the premises relative moisture (r = 0,388 r = 0,397).

Table 2

**Average interior indicators and dependences on the temperature and the relative air moisture**

| Interior indicator | 1 | 2 | Temperature, 0C | | Relative moisture,% | |
|---|---|---|---|---|---|---|
| | | | (r =) | | | ( r = ) |
| | | | 1 | 2 | 1 | 2 |
| Body temperature, 0C | 37,9±0,22 | 38,1±0,37 | 0,195 | 0,192 | -0,248 | - 0,260 |
| Skin temperature, 0C | 32±0,18 | 31,3±0,21 | 0,327 | 0,335 | 0,388 | 0,397 |
| Pulse, beat/min | 74,5±2,4 | 75,3±1,8 | 0,698 | 0,712 | - 0,059 | - 0,058 |
| Breathing, number/min | 21±3,3 | 19,5±1,7 | 0,585 | 0,569 | - 0,716 | - 0,731 |
| Ruminal movements, number/5 min | 9,7±1,2 | 10,2±0,8 | - 0,253 | - 0,292 | - 0,318 | - 0,343 |

The temperature in the buildings has considerable effect on the heart pulse and the breathing frequency. The relative air moisture is not a valid reason for a pulse change. On the other hand, breathing has high causative dependence on the air moisture(r = - 0,716 и r = - 0,731).

We have established similar dependences during an examination of cows, Bulgarian Rhodope cattle, made in the winter (Hristev et al., 2009). In contrast to us, Golubev and authors (Plyashtenko and Hohlova, 1976) report of more frequent pulse and breathing at cows, raised in an ambience with temperature 24,50C and 92% relative moisture - 101 – 121 beats per minute and 33 – 60 breathing movements per minute. According to Semenyuta, (1972), the basic reason for this is the different velocity of air movement during the studies.

Table 3

**Coefficient of adaptability at different temperatures in the sheds**

| Temperature,0C | Dmitriev | | Benezra | | Rauschenbach and Erokhin | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 |
| 15 | 1,32 | 1,24 | 1,9 | 1,84 | 38 | 36,8 |
| 20 | 1,45 | 1,37 | 1,96 | 1,93 | 40 | 37,2 |
| 25 | 1,58 | 1,30 | 2,10 | 2,08 | 44 | 43,8 |
| 30 | 1,71 | 1,53 | 2,23 | 2,14 | 45 | 51,0 |

Indexes of adaptability are given on Table 3. We can conclude that the cows form both sheds are well adaptable to the factors of techno-genic ambience. According to Tom`s coefficient (1959), it is beyond the optimum borders. According to Morrison, this tolerance to the temperature-moisture regime is on account of the increased expenses in order to preserve the organism homeostasis.

## CONCLUSIONS

1. Body and skin temperature of cows, Bulgarian black-colored cattle, raised in two types of sheds, vary in the borders of the physiologic norm. Their skin temperature depends weakly on the temperature (r = 0,195 and r = 0,192), while their skin temperature is in moderate dependence on the temperature (r = 0,327 r = 0,335), and the relative moisture of air in the buildings (r = 0,388 r = 0,397).

2. Pulse and breathing frequency are in positive and high causative dependence on the temperature maintained in the buildings (r = 0,698 and r = 0,712) and (r = 0,585 and r =0,569). In relation to the relative moisture of air, breathing frequency is in high negative correlation (r = - 0,716 и r = - 0,731).

3. Cows, Bulgarian black-colored cattle, raised in two types of buildings in the summer, demonstrate good dynamic homeostasis.

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