Ann. For. Res. 66(1): 111-117, 2023
ISSN: 18448135, 20652445

ANNALS OF FOREST RESEARCH
www.e-afr.org

CHANGES IN MILK PRODUCTIVITY AND ITS QUALITY DEPENDING ON AIR TEMPERATURE IN COWS OF DIFFERENT BREEDS

Turdikulov Tairkul
Candidate of Agricultural Sciences, Associate Professor, Gulistan State University

Annotation
The article presents research materials of high temperature and solar insolation on the quantitative and qualitative composition of milk in black-and-white and Bushuy cattle breeds. The study data showed that high air temperature and solar radiation have a significant negative effect on metabolic processes in the body of animals, as a result of which their physiological state deteriorates, the biochemical components of the blood change, accompanied by a decrease in the productivity of cows and the nutritional value of their milk. The results of the study indicate the need to keep lactating cows during the hot time of the day under a canopy, in well-ventilated rooms, which are an important positive factor affecting the physiological state of the body, productivity and nutritional value of milk.
Key words: biochemical parameters of blood, air temperature, solar insolation, quantity and quality of milk.

Introduction

Features of the climatic conditions of Central Asia, including Uzbekistan, are dry and hot summers, accompanied by high temperatures and intense solar radiation. Prolonged exposure to high temperatures and intense solar radiation on the body of an animal causes a deterioration in its health, a decrease in productivity and general resistance, as well as reproductive qualities. If the high temperature, approaching the body temperature of the animal, impedes heat transfer, then insolation also causes the absorption of heat from the outside, while significantly increasing the adverse effect of high temperature on the body, leading in some cases to metabolic and thermoregulation disorders [1, 2, 3, 4].

You need to know what physiological characteristics determine the physiological resistance of cattle to unfavorable environmental factors in a hot climate and what mechanisms, in addition to thermoregulatory ones, are mobilized to alleviate the tension of all vital functions of the body of lactating cows, since it is known that climatic factors cause quantitative and qualitative changes in the main production of dairy cattle. In addition, the question of the rational maintenance of highly productive cows in hot climates in order to use the potential reserves of the animal organism in increasing the quantity and improving the quality of milk is gaining great practical importance and theoretical significance. In this regard, the task of this study was to identify the effect of high temperature and solar insolation on the quantitative and qualitative composition of milk in black-and-white and Bushuy cattle breeds. This will make it possible to purposefully use the biological characteristics of each breed, taking into account the productive traits.

When studying the effect of high temperature and insolation on the quantitative and qualitative indicators of cattle milk, the main attention was paid to physiological and biochemical changes in the processes of metabolism, milk formation and milk production in highly productive animals, in which the intensive lactation period took place in different (winter and summer) seasons of the year.Tis known that at high temperatures, especially significant shifts in physiological functions are found in highly productive animals, as well as in cows at an earlier stage of lactation [2, 5, 9].

Materials and methods

As already noted, a specific feature of Uzbekistan is a hot, dry summer, with the highest temperatures (38-43°C) in the daytime.

To study interbreed differences in the main physiological functions and biochemical parameters of blood and milk, animals were selected according to the analog method, taking into account the calving season, lactation period, live weight and productivity from clinically healthy cows, typical of the Black-and-White and Bushuy breeds.

The experimental animals were fed according to the norms adopted in the farm and in the corresponding recommendations of the Ministry of Agriculture of the Republic of Uzbekistan.

In order to study the eatability of feed depending on the ambient temperature, we conducted an experiment in which we observed how feed consumption occurs “in the shade” and “in the sun”. During the hot hours of the day (from 12:00 to 16:00), the animals were kept in a well-ventilated barn (“in the shade”) for three days, and on the last or third day, milk and blood samples were taken (15-16 hours of the day). In addition, “in the shade” and “in the sun”, the respiration rate and pulse rate, body temperature, taking into account the temperature and humidity of the air, and the intensity of solar radiation were studied in these animals.

Body temperatures - measured by the conventional method - rectally; breathing - counted by the number of exhalations per minute; pulse rate - by the number of beats per minute (the pulse was determined on the artery lying on the inner side of the thigh).

The milk production of each cow was counted by control milking once every 10 days.

During the experiment, the animals were individually (daily) fed, taking into account the assigned feed and residues. To assess the usefulness of feeding and the level of energy, carbohydrate and protein nutrition of the experimental cows, the chemical composition, nutritional value and quality of feed, biochemical parameters of blood and milk were studied. The content of total protein and its fractions - albumin and globulin, sugar, inorganic phosphorus, lipoid phosphorus, fatty acids and cholesterol - was determined in the blood. Total protein was determined by refractometry; protein fractions - by electrophoresis; sugar - according to the Hagedorn-Jensen method; cholesterol - according to the Engelhardt-Smirnova method; fatty acids - by the modified Bloor-Pelkan-Allen method; inorganic and lipoid phosphorus - by the modified Briggs method.

Research results

It has been established that the effect of high temperatures and intense solar radiation on the body of animals, leading to thermal stress, is accompanied by an increase in body temperature, increased respiration and pulse rate. In addition, overheating of the animal body “in the sun” leads to a significant, even in some cases, a sharp disruption of metabolic processes and a decrease in feed

consumption. So, in the group of winter calving cows due to heat stress, the number of breaths increased from 40 to 59 movements, the pulse rate, respectively, from 71 to 75 beats per minute, total protein - from 8.69 to 8.89 g%. A particularly sharp change in metabolic processes under the influence of high temperature and solar insolation is observed in the group of summer calving cows. If in the group of cows in the "shade" the number of breaths averaged 51 movements, the pulse rate was 76.3 beats per minute, the total protein content was 8.80 g%, then "in the sun" the same indicators were, respectively, 80, five; 82.8 and 9.26.

Heat stress can reduce feed intake in dry matter by up to 40% compared to thermal comfort, leading to a drop in daily milk yield. So, if, when keeping and feeding cows in relatively cool rooms, the remainder of feed on average per head was 3.0 kg (with a given norm of alfalfa in the amount of 25 kg), then when they were transferred to an open area under the sun, this amount increased to 4, 9 kg, or 38.8%, which is caused by the unfavorable effect of insolation, which reduces the need for feed and leads to significant changes in metabolic processes and a decrease in animal productivity.

All this leads not only to a quantitative, but also a qualitative change in the biochemical parameters of blood and milk associated with the productivity of lactating cows.

The discussion of the results

From the data presented (Tables 1 and 2), it can be seen that keeping animals "in the sun" significantly increases clinical parameters and decreases almost all biochemical blood components, except for protein and its beta and gamma-globulin fraction, in comparison with their content "in shadows ". It should be emphasized here that animals with different calving seasons, even within the same breed, show different reactions to high temperatures and solar insolation. For example, when animals are transferred from well-ventilated barns to a sun site, the level of physiological parameters is much higher and blood metabolites change sharply in cows that calved in the summer months of the year, coinciding with the period of the highest air temperature and intense solar insolation, compared with cows that calved in winter months. So, if the increase in body temperature in black-flecked cows of winter calving was higher on the sun site than in the "in the shade" only by 0.3 ° C, the number of breaths - by 18.9 movements and the pulse rate - by 4.6 beats per minute, then in cows of summer calving, they corresponded to 0.7 ° C; 29.5 breaths and 7.5 strokes, i.e. more by 1.5-2.0 times (table 1). A similar, no less pronounced dynamics can be observed in cows of the Bushuev breed with different calving seasons (table 2).

The increase in physiological parameters in cattle under the influence of high temperatures in hot climates is indicated in the works of [2, 4, 8, 9, 10] and etc.

Blood indicators characterizing the state of the metabolic process in cows with different calving seasons indicate a decrease in the concentration of sugar in the blood "in the sun", compared to "with the shadow" by 10.5 mg%, or not 16.3% in the black-and-white cattle of summer calving and by 5.5 mg%, or 9.2% - Bushuevsky; inorganic phosphorus, respectively: by 0.86 and 0.53 mg% or by 12.9 and 7.4%, lipoid phosphorus - by 1.58 and 1.10 mg% or by 14.3 and 8.8%, fatty acids - by 42.7 and 32.0 mg% or 13.4 and 9.1%, cholesterol - by 22.4 and 15.3 mg% or 13.7 and 8.6% (table 1 and 2).

The decrease in the biochemical parameters of blood in the open area in animals calving in winter is insignificant compared to animals calving in summer.

Table 1

Changes in some physiological parameters and biochemical blood components in black-flecked cattle under the influence of high temperature and shading factor

Indicators	Winter calving cows (n = 5)		Summer calving cows (n = 5)	
	"in the shadow"	"in the sun"	"in the shadow"	"in the sun"
Body temperature, °C	38,4 ± 0,06	38,7 ± 0,12	38,6 ± 0,04	39,3 ± 0,17
The number of breaths in 1 min	40,2 ± 1,37	59,1 ± 5,56	51,0 ± 2,32	80,5 ± 7,02
Pulse rate, in 1 min	70,5 ± 1,63	75,1 ± 0,83	76,3 ± 1,68	83,8 ± 1,60
Total protein, g%	8,69 ± 0,06	8,89 ± 0,07	8,80 ± 0,05	9,26 ± 0,07
Albumin,%	43,61 ± 0,50	40,91 ± 0,51	47,05 ± 0,58	42,93 ± 0,42
Globulins,%: α-	12,18 ± 0,14	11,51 ± 0,19	13,00 ± 0,12	11,92 ± 0,16
β-	10,91 ± 0,19	11,09 ± 0,11	10,81 ± 0,22	11,46 ± 0,18
γ	33,30 ± 0,18	36,49 ± 0,59	29,13 ±0,45	33,69 ± 0,53
Sugar, mg %	63,00 ± 0,62	58,25 ± 0,50	64,40 ± 0,60	53,90 ± 0,54
Inorganic phosphorus, mg%	5,88 ± 0,06	5,19 ± 0,08	6,69 ± 0,08	5,83 ± 0,09
Lipoid phosphorus, mg%	10,46 ± 0,37	9,36 ± 0,35	11,06 ± 0,17	9,48 ± 0,24
Fatty acid, mg%	277,80 ± 3,54	258,6 ± 3,29	319,5 ± 4,02	276,8 ± 2,83
Cholesterol, mg%	140,50 ± 2,89	127,9 ± 2,87	164,0 ± 1,69	141,6 ± 1,83

For example, the decrease in the amount of sugar when animals were kept “in the sun” as compared to keeping them in “in the shade” was only 4.75 mg% or 7.5% in black-and-white and 3.10 mg% or 5.2% - Bushuy cows, inorganic phosphorus, respectively: 0.69 and 0.29 mg% or 11.7 and 4.5%, lipoid phosphorus - 1.10 and 0.66 mg% or 10.5 and 5.5%, fatty acids - 19.2 and 14.5 mg% or 6.9 and 4.7%, cholesterol - 12.6 and 8.7 mg per 100 ml of blood or 8.7 and 5.7%.

Table 2

Changes in some physiological parameters and biochemical blood components in Bushuy cattle under the influence of high temperature and shading factor

Indicators	Winter calving cows (n = 5)		Summer calving cows (n = 5)	
	"in the shadow"	"in the sun"	"in the shadow"	"in the sun"
Body temperature, °C	38,2 ± 0,07	38,5 ± 0,12	38,4 ± 0,04	38,8 ± 0,06
The number of breaths	34,7 ± 2,00	42,8 ± 2,18	43,0 ± 1,69	62,2 ± 3,24

in 1 min				
Pulse rate, in 1 min	66,0 ± 1,73	70,3 ± 1,38	72,3 ± 2,34	80,3 ± 1,47
Total protein, g%	8,75 ± 0,02	8,88 ± 0,04	8,79 ± 0,07	9,05 ± 0,08
Albumin,%	40,88 ± 0,89	38,77 ± 0,72	46,03 ± 0,47	42,95 ± 0,57
Globulins,%: α-	13,40 ± 0,12	12,75 ± 0,21	14,45 ± 0,32	13,11 ± 0,16
β-	12,44 ± 0,21	12,43 ± 0,18	12,34 ± 0,22	12,60 ± 0,22
γ	33,28 ± 0,76	36,05 ± 0,52	27,18 ±0,56	31,34 ± 0,74
Sugar, mg %	59,20 ± 0,96	56,10 ± 0,49	59,90 ± 0,94	54,40 ± 0,71
Inorganic phosphorus, mg%	6,40 ± 0,15	6,11 ± 0,12	7,18 ± 0,07	6,65 ± 0,15
Lipoid phosphorus, mg%	11,97 ± 0,26	11,31 ± 0,31	12,48 ± 0,16	11,38 ± 0,23
Fatty acid, mg%	307,70 ± 5,85	293,2 ± 5,84	353,5 ± 4,15	321,5 ± 4,83
Cholesterol, mg%	152,20 ± 3,41	143,5 ± 3,37	178,4 ± 3,65	163,1 ± 2,68

The dynamics of blood protein substances when animals are transferred to an open area under the sun occurs in a slightly different direction, namely: an increase in total protein is observed, mainly due to its γ-globulin fraction and a decrease in albumin and α-globulins. But the change in the protein fraction of blood under the influence of high temperature and solar insolation is insignificant in comparison with its other biochemical parameters. Thus, in black-and-white cows of summer calving, the increase in total protein when kept "in the sun" was only 5.2%, γ-globulins - 15.7%, β-globulins - 6.0%, while the decrease in albumin was 8 , 8% and α - globulins - 8.3%. In black-and-white cows of winter calving, these indicators changed slightly - respectively: by 2.3, 9.6, 1.7% and 6.2, 5.5%.

The dynamics of protein substances in Bushuy cows is similar to that in black-flecked cows, but less pronounced than in the latter. Similar changes are also noted in the works of [3, 6, 7] and others.

On the other hand, it is of great practical importance to study the degree of influence of these climatic factors on milk productivity, the composition and properties of cows' milk. Our research has established that in summer calving cows, the intensive months of lactation of which coincide with the hot summer period, the average daily milk yield and the main components of their milk decrease more sharply in comparison with those in winter calving cows.

As can be seen from the above research results (table 3), when animals are transferred from relatively cool barns to a sun site, the decrease in average daily milk yield in black-and-white cows of summer calving is: 2.10 kg or 12.1%, and in cows of winter calving 1 .21 kg or 10.3%; in Bushuy cows, respectively: 1.45 kg or 11.0% and 0.90 kg or 9.3%. When animals are kept in a sun area, the main ingredients of milk are also reduced compared to cows that are indoors during the daytime.

Table 3

Dynamics of milk constituents in cattle with different calving seasons under the influence of high temperature, solar radiation and shading factor

Indicators	Black and white breed		Bushuevskaya breed	
	"in the shadow"	"in the sun"	"in the shadow"	"in the sun"
Winter calving cows (n = 12)				
Milk yield, kg	11,79 ± 0,74	10,58 ± 0,72	9,67 ± 0,76	8,77 ± 0,70
Fat,%	3,92 ± 0,11	3,71 ± 0,10	4,37 ± 0,14	4,16 ± 0,14
Protein, %	3,35 ± 0,02	3,24 ± 0,05	3,51 ± 0,06	3,44 ± 0,05
Sugar, %	4,57 ± 0,03	4,51 ± 0,02	4,57 ± 0,03	4,71 ± 0,03
Summer calving cows (n = 12)				
Milk yield, kg	17,30 ± 1,03	15,20 ± 1,22	13,13 ± 0,84	11,68 ± 0,96
Fat,%	3,42 ± 0,05	2,96 ± 0,05	3,78 ± 0,02	3,49 ± 0,03
Protein, %	3,09 ± 0,02	2,94 ± 0,03	3,31 ± 0,02	3,20 ± 0,03
Sugar, %	4,89 ± 0,03	4,78 ± 0,03	4,98 ± 0,02	4,89 ± 0,02

Thus, the relative decrease in its constituent parts for black-and-white cattle was: fat - 13.4% at a summer hotel and by 5.3% in winter, protein, respectively: by 4.8 and 3.3%, sugar - by 2, 2 and 1.3%. For Bushuy cattle, the percentage of these elements "in the sun" was lower: fat by 7.7% in summer and 4.8% in winter calving, protein, respectively: by 3.3 and 2.0%, sugar - by 1, 8 and 0.9%.

The results of our research are confirmed by [1, 8, 9] etc. states that cows in the early stages of lactation suffer the most from the heat.

The change in milk composition indicators under the influence of thermal factors shows that a sharp decrease in the amount of fat in milk is observed in summer calving cows, compared with winter ones, when they are kept in an open area in summer. At the same time, the difference in dynamics between other components of milk in cows with different calving seasons is small, which indicates a more stable and stable nature of their nature in relation to and environmental factors.

Conclusion

Thus, on the basis of all of the above, it must be assumed that high air temperature and solar radiation have a significant effect on metabolic processes in the body of animals, as a result of which their physiological state deteriorates and the biochemical components of the blood change, which is accompanied by a decrease in the productivity of cows and the nutritional value of their milk.

These changes in the level of blood metabolites and a decrease in the milk production of animals are more pronounced in cows of summer calving compared to winter ones.

Keeping animals in the summer, in the hot part of the day “in the shade” (under a canopy, in a well-ventilated area) under appropriate feeding conditions is a positive factor affecting the physiological state, all vital functions of the body of lactating cows, their productivity and nutritional value of milk.

Used literature:

1. Akhmadaliev NA, Ruziev TB: Adaptation of imported dairy cattle to the conditions of a subtropical climate. Reports of the Tajik Academy of Agricultural Sciences. 2015. No. 1 (43). P. 38-42.
2. Dostmukhammedova M.Kh .: Heat resistance and milk productivity of Holsteinized black-and-white cows // Veterinary Medicine. 2008, No. 9, - P.30-31.
3. Kirichenko I.V. Dynamics of proteins and protein fractions in the blood serum of Simmental cattle depending on age, keeping conditions and breed. Proceedings of the Kharkov Agricultural Institute, v. 34, 1961, p. 103-108.
4. Mokhov BP: Dynamics and structure of exchange energy consumption in conditions of weather stress // Bulletin of the Ulyanovsk State Agricultural Academy. - 2014, No. 1. - P. 136-139.
5. Rauschenbach Yu.O .: Heat and cold resistance of farm animals. Novosibirsk, "Science", 1975. – P. 46.
6. Seitkamalov Kh.M., Mambetullaeva S.M .: Study of the composition and properties of the blood system in lactating cows in the conditions of the Southern Aral region // World Science, 2019. No. 6 (27). P. 423-427.
7. Chasovshchikova MA: Improvement of breeding and productive qualities of black-and-white cattle of the Northern Trans-Urals: diss. Doctor of Agricultural Sciences. Tyumen, 2016. 380 p.
8. Tavildarova TF: Issues of livestock acclimatization in Uzbekistan. Bulletin of animal husbandry, issue 4, 1946, p. 33-44.
9. Filatov AV: - Productive and acclimatization abilities of black-and-white Holstein cattle in the zone of the lower Volga region. Abstract of Cand. diss. Volgograd, 2005.
10. Bruyere P .: De L'adaptation des bovins aux climate chands. Ann. med. veterin., 97, No. 4, 1983, p. 205-243.