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## THE CONDITION OF THE CATTLE'S HAIR COAT DURING ADAPTATION

©*Qo'chqorov A.*, ORCID: 0009-0006-0816-1281, Tashkent Branch of Samarkand State University Of Veterinary Medicine, Animal Husbandry and Biotechnology, Tashkent, Uzbekistan, [qochqorovabdukarim3355@gmail.com](mailto:qochqorovabdukarim3355@gmail.com)

## СОСТОЯНИЕ ВОЛОСЯНОГО ПОКРОВА КРУПНОГО РОГАТОГО СКОТА В ПРОЦЕССЕ АДАПТАЦИИ

©*Кучкаров А. Н.*, ORCID: 0009-0006-0816-1281, Ташкентский филиал Самаркандского государственного университета ветеринарной медицины, животноводства и биотехнологии, г. Ташкент, Узбекистан, [qochqorovabdukarim3355@gmail.com](mailto:qochqorovabdukarim3355@gmail.com)

*Abstract.* The productivity and adaptive performance of beef cattle are closely associated with their ability to respond to changing environmental conditions. In this study, seasonal changes in the hair coat of Aberdeen Angus cattle were examined as a functional indicator of adaptation to the natural and climatic conditions of Uzbekistan. The research was conducted from January 2021 to November 2024 at the Qurama Karabayir farm in the Ohangaron District of the Tashkent Region. Three experimental groups, each consisting of 10 animals, were studied. Hair coat mass per 1 cm<sup>2</sup> of skin surface, fiber length, fiber density, and the thickness of individual fiber types were assessed in winter and summer. The results demonstrated pronounced seasonal variation in all major hair coat characteristics. Winter was associated with an increase in hair mass, length, and density, whereas summer was characterized by a marked reduction in these parameters. The offspring of Timo bulls demonstrated the most pronounced seasonal response and generally showed the strongest adaptive characteristics among the groups. The findings indicate that the cattle hair coat functions as an important physiological component of thermoregulation and environmental adaptation. The study also supports the potential use of Aberdeen Angus cattle of German selection in the development of specialized beef herds under the conditions of the Republic of Uzbekistan.

*Аннотация.* Продуктивность и адаптационные способности мясного скота тесно связаны с его способностью реагировать на изменения условий внешней среды. В настоящем исследовании сезонные изменения шерстного покрова крупного рогатого скота породы абердин-ангус были изучены как один из функциональных показателей адаптации к природно-климатическим условиям Республики Узбекистан. Исследования проводились с января 2021 года по ноябрь 2024 года в фермерском хозяйстве «Qurama qorabayirlari», расположенном в Ахангаранском районе Ташкентской области. Были сформированы три опытные группы по 10 животных в каждой. В зимний и летний периоды изучались масса шерсти на 1 см<sup>2</sup> поверхности кожи, длина и плотность шерстных волокон, а также толщина отдельных типов волокон. Полученные результаты показали выраженную сезонную изменчивость основных характеристик шерстного покрова. В зимний период наблюдалось увеличение массы, длины и плотности шерсти, тогда как летом отмечалось существенное снижение данных показателей. Потомки быков линии Тимо характеризовались наиболее выраженной сезонной реакцией и в целом обладали наиболее высокими адаптационными показателями среди исследованных групп. Установлено, что шерстный покров является важным физиологическим компонентом терморегуляции и адаптации крупного рогатого скота к условиям внешней среды. Результаты

исследования также подтверждают перспективность использования абердин-ангусского скота немецкой селекции для формирования специализированных мясных стад в условиях Республики Узбекистан.

*Keywords:* Aberdeen Angus cattle; hair coat; seasonal adaptation; thermoregulation; hair fiber; climatic conditions; beef cattle.

*Ключевые слова:* абердин-ангусский скот; шерстный покров; сезонная адаптация; терморегуляция; шерстное волокно; климатические условия; мясное скотоводство.

The development of beef cattle production remains an important priority for the livestock sector of Uzbekistan. The domestic cattle industry still does not fully satisfy the population's demand for high-quality beef, which makes the expansion of specialized beef production and the more efficient use of productive genetic resources increasingly important. One practical approach involves the development of beef herds through the breeding of specialized beef cattle and the crossing of dairy and dual-purpose breeds with beef bulls. Beyond increasing the supply of meat and other food products, the development of livestock production contributes to rural employment and household incomes.

The ability of cattle to adapt to local climatic conditions is one of the key factors determining the success of introducing and maintaining productive breeds. Among the external structures involved in adaptation, the hair coat deserves particular attention. It forms an important interface between the animal and its environment and contributes directly to the regulation of heat exchange. The condition and structure of the hair coat determine the efficiency of heat retention during cold periods and the dissipation of excess heat during hot periods. In winter, a dense and sufficiently long hair coat reduces heat loss and protects the skin and internal tissues. This may also reduce the amount of feed-derived energy required for maintaining body temperature. In summer, however, excessive hair density and length can interfere with heat exchange and reduce the efficiency of heat dissipation. In this context, seasonal changes in the hair coat represent a biologically meaningful adaptive response rather than simple external variation. The hair coat is also a dynamic structure. Its mass, length, density, and fiber composition change in response to environmental conditions. Therefore, the study of these characteristics provides useful information about the adaptive capacity of cattle and the extent to which a particular genetic group is able to respond to climatic stress. This issue is especially relevant when beef cattle are introduced into climatic conditions that differ from those of their original breeding environment [1-4].

The objective of this study was to assess seasonal changes in the hair coat of Aberdeen Angus cattle and to evaluate the adaptive characteristics of different genetic groups under the natural and climatic conditions of Uzbekistan. The productive performance of cattle is determined by the interaction of genetic potential and environmental factors. Earlier studies have emphasized the importance of feeding and housing conditions as major phenotypic factors affecting productivity and product quality. B. Abdalniyozov and R. Khudoyorov (2007), Kh. Ergashev et al. (2007), A. Kho'jabekov (2007), and I. Maqsudov et al. (2008) noted that the full realization of the productive potential of cattle depends substantially on the quality of feeding and the conditions under which animals are kept [5-8].

A review of previous research indicates that growth, development, and meat productivity are strongly influenced by the type and level of feeding, as well as by housing technology. These observations are particularly important for young beef cattle, whose genetic potential can only be expressed fully when the production environment is appropriately managed.

The effect of housing and management conditions on beef productivity was also demonstrated in a study involving six-month-old Swiss breed calves divided into three experimental groups [6].

The animals were kept under different combinations of indoor and open-area conditions. Over the 364-day experimental period, feed consumption, live weight, slaughter characteristics, and profitability differed among the groups. The findings showed that a combination of indoor housing, open-area management, and final indoor finishing could provide favorable production results. At the same time, the adaptive response of cattle cannot be evaluated solely through productive indicators. Morphological and physiological traits that reflect the interaction between the animal and its environment are equally important. The hair coat is one such trait. Its seasonal dynamics may provide a practical indicator of thermoregulatory adaptation and may help explain differences in the ability of cattle from different genetic groups to tolerate environmental conditions.

### *Materials and methods*

The study was conducted from 6 January 2021 to 30 November 2024 at the Qurama Karabayir farm in the Ohangaron District of the Tashkent Region, Uzbekistan. The farm was selected because its location and production conditions were considered suitable for cattle husbandry. The local climate is characterized by hot and dry summers, relatively cold winters, and comparatively rainy springs. To study adaptation and productive characteristics, three experimental groups of 10 animals each were formed. The experimental cattle belonged to Aberdeen Angus genetic groups associated with the offspring of Timo, REA Imper, and Terron bulls. The functional activity index was calculated according to the method proposed by Kovalchikova and Kovalchik. Natural resistance was assessed seasonally through the study of serum bactericidal activity [1, 2].

Behavioral observations were conducted over two consecutive days using visual observation and time-recording methods. The durations of lying, standing, feeding, water consumption, and movement were recorded. Both absolute and relative time expenditures for individual behavioral elements were determined. Growth rate was assessed monthly by individual weighing in the morning before feeding and watering. The hair coat was evaluated in winter (January) and summer (July). The main parameters included hair mass per 1 cm<sup>2</sup> of skin surface, hair fiber length, and hair fiber density. The thicknesses of the principal, intermediate, and down fibers were also assessed. The results were compared among the three experimental groups.

### *Results and Discussion*

Seasonal changes in the hair coat were clearly expressed in all experimental groups. The winter period was characterized by a substantial increase in hair mass, fiber length, and fiber density, whereas all three parameters declined markedly during the summer. This pattern indicates that the hair coat of Aberdeen Angus cattle undergoes a pronounced seasonal transformation associated with thermoregulatory adaptation.

The highest hair mass per 1 cm<sup>2</sup> of skin surface was recorded in the summer in Group I, consisting of the offspring of Timo bulls (15.84 mg). This value was significantly higher ( $P < 0.05$ ) than the corresponding values observed in the offspring of REA Imper and Terron bulls. In winter, Group I also demonstrated a significant advantage over the other groups regarding this indicator.

The seasonal contrast was particularly pronounced in hair mass. In winter, the values were  $85.00 \pm 0.48$  mg in Group I,  $81.53 \pm 0.40$  mg in Group II, and  $82.91 \pm 0.75$  mg in Group III. In summer, the respective values decreased to  $15.82 \pm 0.46$  mg,  $14.03 \pm 0.45$  mg, and  $12.87 \pm 0.46$  mg. Thus, the winter hair coat was substantially denser and heavier, and its reduction during summer may facilitate heat dissipation.

A similar seasonal pattern was observed for hair fiber length. In winter, the length reached  $42.84 \pm 1.00$  mm in Group I,  $40.19 \pm 0.87$  mm in Group II, and  $38.67 \pm 0.75$  mm in Group III. By summer, the values decreased to  $13.14 \pm 0.98$  mm,  $15.24 \pm 1.00$  mm, and  $15.81 \pm 0.89$  mm, respectively. The shortest summer fibers were observed in Group I, which may be considered a favorable adaptive characteristic, as a shorter hair coat can facilitate sweat evaporation from the skin surface.

Hair fiber density also demonstrated clear seasonal variability. In winter, more than 1,400 fibers per  $\text{cm}^2$  were recorded in all groups:  $1,461.19 \pm 19.46$  in Group I,  $1,402.27 \pm 19.29$  in Group II, and  $1,396.69 \pm 19.58$  in Group III. During summer, the values declined to approximately 728–803 fibers per  $\text{cm}^2$ . These findings indicate that the seasonal response involves not only changes in hair mass and length but also substantial changes in fiber density. Taken together, the data indicate that Aberdeen Angus cattle possess a pronounced seasonal mechanism for hair coat adjustment. A dense, long, and relatively heavy hair coat develops during winter, while a shorter and less dense coat predominates in summer. Such a response is consistent with the functional requirements of thermoregulation and suggests successful adaptation to the climatic conditions of the study area.

Table 1

SEASONAL CHARACTERISTICS OF THE CATTLE HAIR COAT (2024)

| Parameter                                 | I Winter              | I Summer              | II Winter          | II Summer          | III Winter         | III Summer         |
|-------------------------------------------|-----------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|
| Hair mass per 1 $\text{cm}^2$ , mg        | $86.00 \pm 0.50^{**}$ | $15.84 \pm 0.48^{**}$ | $81.54 \pm 0.42^*$ | $14.05 \pm 0.48^*$ | $82.94 \pm 0.76$   | $12.89 \pm 0.48$   |
| Hair fiber length, mm                     | $42.84 \pm 1.00^{**}$ | $13.14 \pm 0.98^{**}$ | $40.19 \pm 0.87^*$ | $15.24 \pm 1.00^*$ | $38.69 \pm 0.77$   | $15.84 \pm 0.92$   |
| Hair fiber density, fibers/ $\text{cm}^2$ | $1461.20 \pm 19.5$    | $803.10 \pm 21.02$    | $1402.29 \pm 19.3$ | $754.61 \pm 13.81$ | $1396.71 \pm 19.6$ | $728.14 \pm 18.79$ |

Note: \*  $P > 0.95$ ; \*\*  $P > 0.99$ ; statistically significant

Hair fiber mass is an important indicator; however, fiber length and density are particularly informative when evaluating seasonal adaptation. Excessively long and dense hair during hot weather may interfere with heat exchange and increase the physiological burden of thermoregulation. In such conditions, respiratory rate may increase, respiratory depth may decrease, and sweating may intensify, thereby increasing energy and water requirements. Conversely, a shorter and less dense summer hair coat can reduce the need for compensatory thermoregulatory responses.

The results of the present study show that Group I cattle had the shortest summer hair fibers and the longest winter fibers. This pronounced seasonal contrast may reflect a more active adaptive response. The results suggest that the offspring of Timo bulls demonstrated a higher degree of seasonal adaptability than the other groups.

The structure of the hair coat is also important. The coat consists of guard, intermediate, and down fibers. Guard fibers are the longest and thickest, whereas down fibers are the shortest and finest. The proportion and thickness of these fiber types are associated with the animal's ability to respond to environmental changes. In winter, a greater contribution of the undercoat is advantageous because numerous fine fibers create a dense air layer and improve thermal insulation.

Seasonal changes in fiber thickness were observed across all groups. The thickening of fibers in winter and their relative thinning in summer represent an important physiological component of adaptation. The highest winter guard-fiber thickness was recorded in Group I ( $65.5 \pm 1.16$   $\mu\text{m}$ ), followed by Group II ( $64.0 \pm 1.36$   $\mu\text{m}$ ) and Group III ( $59.1 \pm 3.14$   $\mu\text{m}$ ). In summer, Group I retained

a relatively high value of  $58.2 \pm 1.33 \mu\text{m}$ , whereas the lowest value was observed in Group II ( $53.5 \pm 1.57 \mu\text{m}$ ).

Intermediate fiber thickness showed smaller differences among the groups. In winter, the highest values were observed in Group II ( $42.6 \pm 1.05 \mu\text{m}$ ) and Group III ( $42.4 \pm 1.57 \mu\text{m}$ ), compared with  $39.2 \pm 1.76 \mu\text{m}$  in Group I. A similar pattern was maintained during summer, when the values were  $41.0 \pm 0.98 \mu\text{m}$ ,  $41.4 \pm 0.80 \mu\text{m}$ , and  $37.2 \pm 0.94 \mu\text{m}$ , respectively.

Table 2

HAIR FIBER THICKNESS IN THE EXPERIMENTAL GROUPS, 2024

| <i>Fiber type</i>                 | <i>I Winter</i>      | <i>I Summer</i>      | <i>II Winter</i>   | <i>II Summer</i>      | <i>III Winter</i> | <i>III Summer</i> |
|-----------------------------------|----------------------|----------------------|--------------------|-----------------------|-------------------|-------------------|
| Guard fiber, $\mu\text{m}$        | $59.3 \pm 3.16^{**}$ | $53.5 \pm 1.57^{**}$ | $64.00 \pm 1.36^*$ | $57.6 \pm 0.94^*$     | $65.5 \pm 1.16$   | $58.2 \pm 1.33$   |
| Intermediate fiber, $\mu\text{m}$ | $39.2 \pm 1.76^{**}$ | $37.2 \pm 0.94^*$    | $42.6 \pm 1.05^*$  | $41.00 \pm 0.98^{**}$ | $42.4 \pm 1.57$   | $41.4 \pm 0.8$    |
| Down fiber, $\mu\text{m}$         | $24.4 \pm 0.84^{**}$ | $17.6 \pm 0.94^*$    | $25.5 \pm 1.06^*$  | $19.01 \pm 0.81^{**}$ | $26.04 \pm 1.48$  | $20.5 \pm 0.6$    |

Note: \*  $P > 0.95$ ; \*\*  $P > 0.99$ ; statistically significant

Intergroup comparisons showed that the offspring of Timo bulls had the highest fiber thickness values across the seasons considered and demonstrated the most pronounced adaptive response to both cold and hot conditions. The offspring of Terron bulls, in contrast, were characterized by lower fiber thickness values and a comparatively less pronounced adaptive response. These findings emphasize the role of both genetic and physiological factors in the thermoregulation of cattle.

### Conclusions

The findings of this study demonstrate that the hair coat of Aberdeen Angus cattle undergoes pronounced seasonal changes in mass, length, density, and fiber thickness. These changes are closely associated with the thermoregulatory and adaptive response of cattle to environmental conditions. Among the experimental groups, the offspring of Timo bulls demonstrated the most pronounced seasonal response and the most favorable combination of hair coat characteristics. The shortest hair fibers in summer and the longest fibers in winter, together with relatively high fiber thickness values, indicate a comparatively strong adaptive capacity. The results support the use of Aberdeen Angus cattle of German selection in the development of specialized beef herds in the Republic of Uzbekistan. When further expanding the use of this genetic resource, priority should be given to breeding lines and offspring demonstrating high productive potential and strong adaptation to the local natural and climatic environment.

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