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CHARACTERISTICS OF SKIN THICKNESS AND GROWTH DYNAMICS OF HAIR-COAT COVERING OF MEAT CATTLES ACCORDING TO THE SEASON

Nikolay MARKOV

Research Institute of Mountain Stockbreeding and Agriculture, 281, Vasil Levski, Troyan, Bulgaria

Corresponding author email: ncm64@mail.com

Abstract

Data on skin thickness and growth dynamics of hair cover of meat cattle of Aberdeen-Angus, Hereford and Limousine breeds, freely raised on the farm of the Research Institute of Mountain Stockbreeding and Agriculture, Troyan, are provided. Skin measurements in the neck, the elbow joint and the middle of the last rib were measured and analysed as well as the structure of different fiber categories of the hair cover. The measurements of skin thickness were performed with the aid of the skin-fold caliper in seasons (winter and summer). The hair weights in 1cm ^{2}, the length and percentage of the different fibers were determined. The animals surveyed show good adaptation plasticity in the process of generational change.

Key words: hair-coat covering, skin thickness, seasons, adaptation, meat cattle

INTRODUCTION

Skin and hair-coat covering of livestock play a particularly important role in the process of adaptation to the external environment conditions, which determines the amount of heat release to a significant degree (Kosylov and Zhaimysheva, 2009; Pozdnyakova et al., 2014; Pozdnyakova et al., 2015)

Many researchers have indicated seasonal, inter-breeding and age differences in skin thickness and hair structure and size (Dragnev, 1969, Balabanov 1972, Vlench, 1999, Pozdnyakova, 2001, Tsirendorjiev and Lumbunov, 2013).

Beef cattle breeds show good adaptive abilities to different climatic conditions due to their low and high temperatures because of their skin structure and construction and their well-differentiated, naturally cohesive hair-coat covering (Zelenkov, 1983; Eremenko, 2001; Baharev, 2011; Kayumov and colleagues, 2014).

Zimin (2006) found that in all the animals studied the individual characteristics of the hair-cover coating and skin were observed. An average skin thickness of 10113 mcm (10.01 mm), thin epidermis and relatively thick hairs were observed in cattle.

Morphological methods allow us to assess the resistance of cattle breeds to the elements of the seasons and their associated acclimatization abilities (Cherekaev, 2010)

The hereditary conditionality between the accumulation of subcutaneous fat and the increase in the thickness of hair-coat covering is a response of their organism to low temperatures, helping to adapt to the constantly changing environmental conditions.

The aim of the study was to investigate the subcutaneous fat accumulation and growth dynamics of the hair-coat covering in the adaptation to meat technology in the foothills of Bulgaria of Aberdeen-Angus, Hereford and Limousine cattle breeds.

MATERIALS AND METHODS

Subject of the study are beef cows of Aberdeen-Angus, Hereford and Limousine breeds, which have completed their development (after III lactation), raised on traditional, meat technology at the farm of the Research Institute of Mountain Stockbreeding and Agriculture. It involves raising cows in open air using a windproof canopy. The main activity of this technology is to inseminate the cows that have to give one calf at the end of the winter, to wean the calf in the end of the autumn in the same year. Thus, they could graze as much as possible and the additional nutrition is minimized. Technically, calves suck until late autumn and after weaning they are fattened.

Three groups of five cows were formed to study the adaptation processes in the animal body by the analogue method, taking into account the breed, age and live weight of each animal. In the first group (I) consisted of Aberdeen-Angus cows, in the second group (II) were Hereford cows, and in the third group (III) the cows of Limousine breed. The skin thickness and the degree of development of hair-coat covering in both groups were studied during the winter, summer and autumn seasons.

The following tests were carried out to measure skin thickness at the neck, at the tip of the hock and in the middle of the last rib in millimeters (mm) using skin-fold calliper.

Samples of the hair-coat covering were cut from the middle of the last rib during each season of the survey. We determined the weight of hair-coat covering in 1 cm² in milligrams (mg) using an analytical balance.

The length of hairs was determined in (mm) by a line. The structure of different hair categories were calculated in percent (%) per 100 examined hairs.

The data was processed by the methods of the variation statistic using the programs Microsoft Excel and Statistica 2000 and presented in tables.

The software products used for the purpose of presenting the correct visualization, as required, are from Microsoft office Word 365.

RESULTS AND DISCUSSIONS

Every modern meat technology is linked, dependent and coherent with natural-climatic factors. The town of Troyan is situated in the center of the Republic of Bulgaria at 400 m above sea level, with average annual air temperature of 14.4 ˚C. A humid continental, mountain climate is observed. Winter is long, with heavy snowfalls and low temperatures. The snow cover lasts for 40-60 days. The coolest month is February, with average temperatures of -3˚C. In the winter, frequent, strong northwest winds occur.

The analysis of the obtained data shows that the skin thickness in the different topographic regions shows differences both in breeds and in seasons.

Table 1. Skin thickness by seasons in mm (x ± Sx)

Indicator Measurements, mm	**Aberdeen-Angus** (I group) n=5	**Hereford** (II group) n=5	**Limousine** (III group) n=5
Winter (January)			
at the neck	10.2±1.10	9.4±0.89	9.6±1.34
at the top of the elbow joint	8.6±1.41	9.0±1.22	8.6±1.82
in the middle of the last rib	9.8±1.30	10.6±0.55	10.0±1.22
Summer (June)			
at the neck	9.2±0.29	9.0±1.41	9.40±0.1.34
at the top of the elbow joint	7.6±1.14	8.6±1.14	8.3±1.34
in the middle of the last rib	9.6±1.52	10.2±0.86	9.60±1.52

P<0.05

In winter, the greatest skin thickness in the middle of the last rib was found in Hereford cows, respectively, 10.6 mm, followed by Limousine cows with 10.0 mm, respectively, and the lowest skin thickness values was found at the last rib in Aberdeen-Angus cows, 9.8 mm and 9.6 mm, respectively. In percentage terms, this was 5.7% higher than Limousine breed, and 8.1% more than the Aberdeen-Angus cows (P<0.05).

During the winter season, the skin thickness of the examined body parts was greater compared to the summer period for all tested animals according to their inherited qualities. Similar peculiarities are also observed in the other animal body parts.

Breed differences in skin thickness are graphically depicted in Figure 1 and Figure 2.

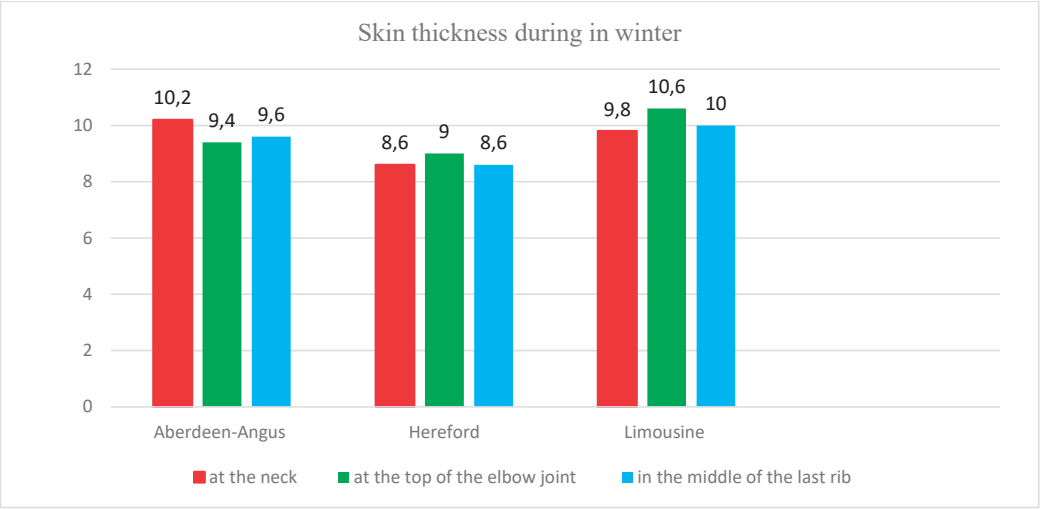

Figure 1. Skin thickness in winter

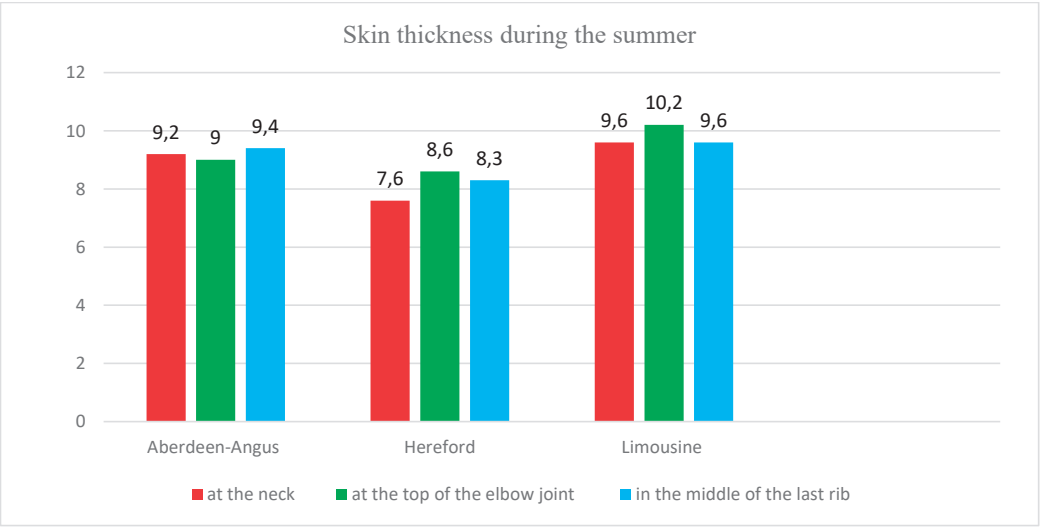

Figure 2. Skin thickness in summer

The results obtained by Zelenkov (1983) and Pözdnydkowa et al. (2015) are close to ours.

The hair-coat covering is a derivative of the skin and is related to its construction and its functions. In the adaptation of animals to the conditions of low temperatures, especially during the winter period, the hair-coat covering plays an important role in the process of regulating the heat exchange between the organism and the environment, and in rain and snow it protects it from wetness and cold (Pozdnyakova et al., 2015).

Table 2. Length, weight and percentage of hair-coat covering (x ± Sx)

Type of hair-coat covering	Breed		
	Aberdeen-Angus (I group) n=5	**Hereford** (II group) n=5	**Limousine** (III group) n=5
Winter (January)			
Length of fibers in mm including awny	35.20±0.13**	43.2±0.21**	41.6±0.41
Transitional	21.20±0.20**	28.4±0.22**	23.2±0.29*
Fluffy	12.0±0.17**	12.20±0.40	14.0±0.42
Weight of hair-coat covering for 1cm², mg	58.83±3.06	56.41±3.73	48.59±3.63
Percentage share of different fibers (%)	100	100	100
Awny	19.8	18.20	22.40
Transitional	18.8	40.20	39.60
Fluffy	61.4	41.60	38.00
Summer (June)			
Length of fibers in cm including Awny	31.04±0.35	38.39±1.36	36.16±0.22*
Transitional	18.51±0.29*	19.11±0.15***	17.34±0.38
Fluffy	9.97±0.14***	11.14±0.15	11.11± 0.26*
Weight of hair-coat covering per 1cm², mg	23.73±0.34*	23.42±0.43	22.92±0.27
Percentage share of different fibers (%)	100	100	100
Awny	22.4	25.1	26.4
Transitional	37.5	41.8	37.2
Fluffy	40.1	33.1	37.4

P<0.05* P<0.01** P<0.001***

In the process of adaptation of animals to the conditions of low temperatures and snow cover during the winter, there were changes in the weight and structure of hair-coat covering.

The highest weight of 1 cm² hair-coat covering was found in Aberdeen-Angus cows, which surpassed Hereford breed by 1.35% and those of Limousine breed by 3.4%. In the summer, this weight decreased drastically and ranged from 22.92 mg in cows from Limousine to 23.73 mg in Aberdeen-Angus cows.

The differences in the length, weight and percentage ratio of the hair fibers are shown graphically by season in Figures 3, 4, 5 and 6.

Substantial changes are also observed in the structure of the hair-coat covering. The awn fibers were the longest in the winter cut from by Hereford Cows with 43.2 mm, followed by Limousine cows with 41.6 mm, and the smallest are those of the Aberdeen-Angus-35.3 mm (P<0.01).

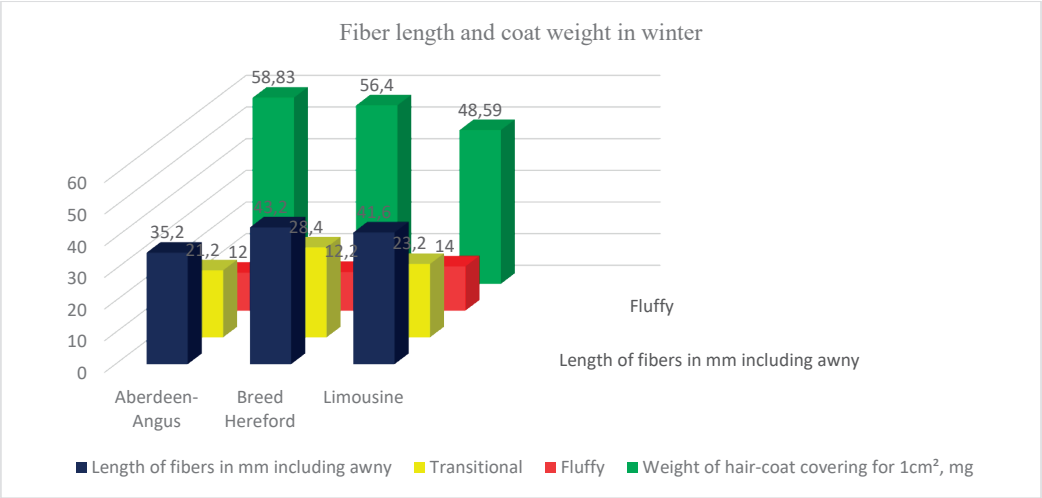

Figure 3. Fiber length and coat weight in winter

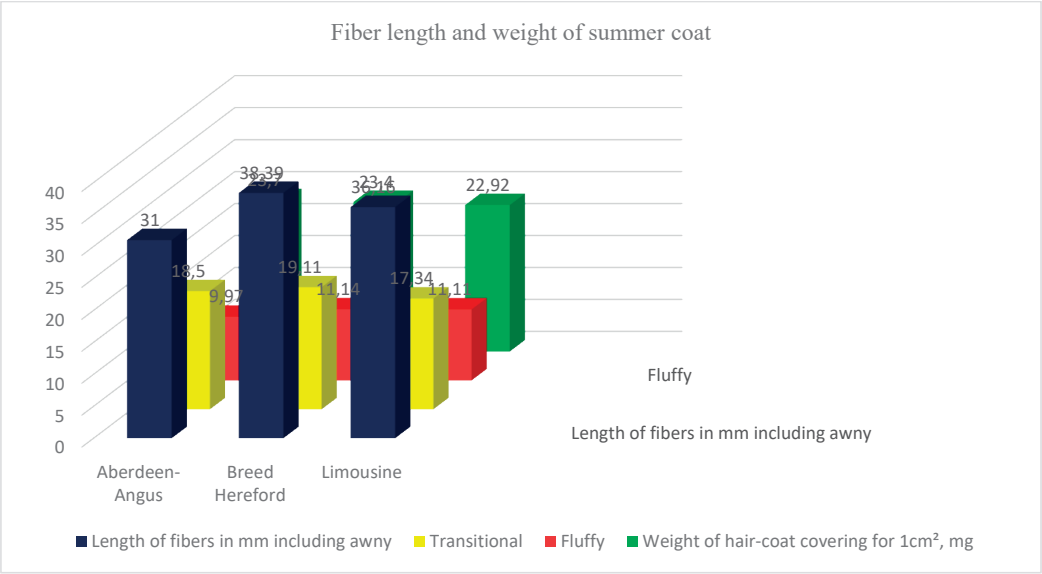

Figure 4. Fiber length and weight of summer coat

The length of the transitional and fluff fibers shows similarities to these differences. Fluff fibers of Aberdeen-Angus cows in winter surpassed by 17.4% Hereford breed, and Limousine cows by 6.7%.

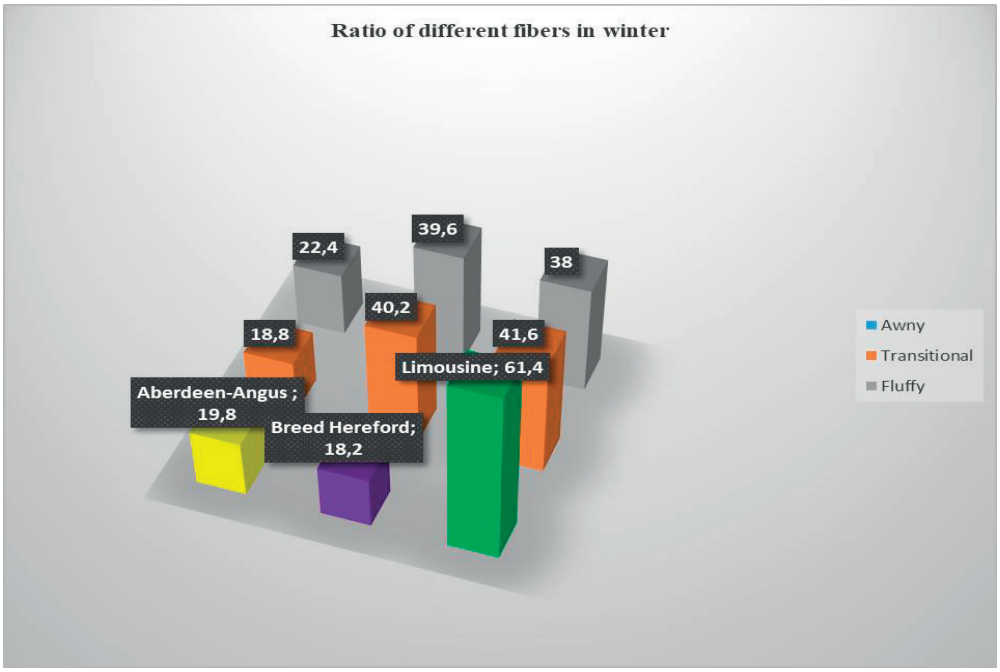

Figure 5. Ratio of different fibers in winter

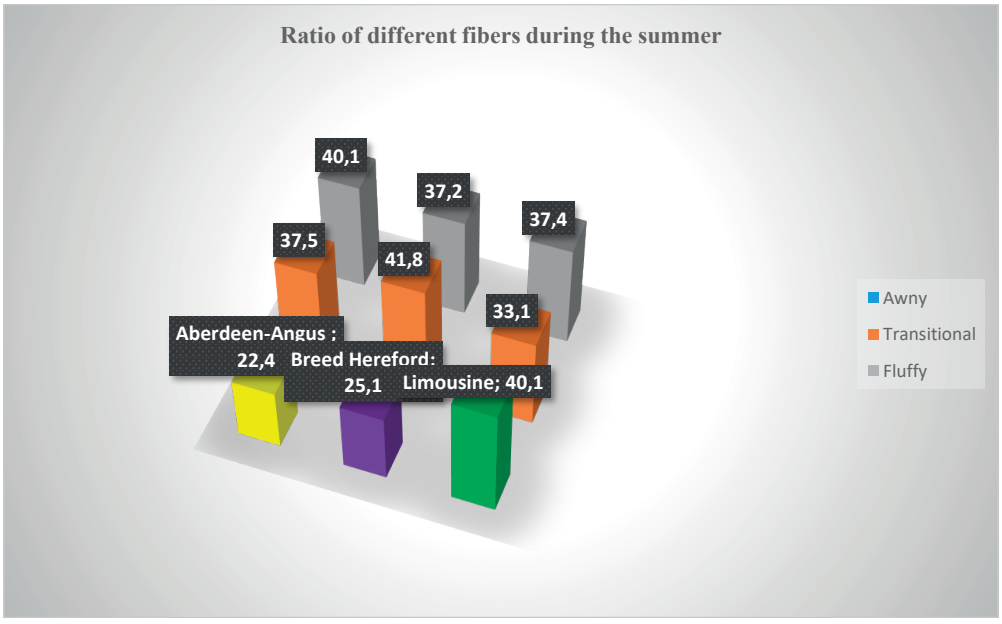

Figure 6. Ratio of different fibers during the summer

The highest values in transitional fibers were found in Hereford breed, followed by Limousine breed, and the lowest values were found in Aberdeen-Angus 18.8%. In summer the values were approximately the same for all three breeds tested - 37.2%, 37.4% and 41.8%. Similar results were obtained from Baharev (2011), Kayumov et all (2014) and Pozdnykova et al. (2015).

CONCLUSIONS

Breed and seasonal differences in skin thickness, hair length and density of hair-coat covering were found. In the winter period, during the adaptation of the animals to the technology, the three breeds increased the weight and length of their hair-coat covering, increasing the percentage of fluff in its structure. In the summer, there was a decrease in the number of fluff fibers and an increase in the number of transitional and any fibers. The studied breeds show good adaptive plasticity towards the humid continental, mountain climate of the town of Troyan, in the process of changing the generations.

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