CHARACTERIZATION OF BEEF WITH DIFFERENT DEGREES OF MARBLING FROM YOUNG ABERDEEN ANGUS CATTLE RAISED IN RUSSIA

Andrey B. Lisitsyn[1], Ilya V. Kozyrev[1], Tatiana M. Mittelshtein[1]

[1] FGBNU V.M. Gorbatov VNIIMP, Moscow, Russia

Abstract – This paper presents a comparison of the meat quality and nutritional value of beef from young Aberdeen Angus cattle raised in Russia and according to their marbling degree.

Key Words – quality traits, marbling, Angus, microstructure

I. INTRODUCTION

At present, an interest of the Russian enterprises in production of high-quality beef grows every year. Use of young cattle of meat direction of productivity upon raising and fattening allows enterprises to obtain products with high quality that corresponds to world standards. With that, the issue of beef objective assessment and its further use in dependence of quality indicators and technological characteristics is of the utmost importance. It has been scientifically proved that one of the objective criteria which reflects meat raw material quality is a degree of marbling. Also, an important factor is that this indicator can be determined on-line. In this connection, investigation of the Russian high-quality beef and detection of differences in the characteristics in dependence of the degree of its marbling is highly topical.

II. MATERIALS AND METHODS

As a subject of research, we used the samples of *longissimus dorsi* muscle from Aberdeen Angus steers in the age of 16 months, which were raised in the pasture conditions with use of grass feeding during raising and intensive feeding with high energy grain feed at the finishing stage (100 days). The analyses of the physico-chemical, structural and mechanical, microstructural and technological properties and vitamin content were carried out.

III. RESULTS AND DISCUSSION

The first stage of the work included the study of the relationships between the organoleptic traits of beef marbling and the microstructural, technological and physico-chemical properties of meat.

Table 1 presents the proximate composition, vitamin content, color characteristics, shear force, moisture binding capacity, *in vitro* digestibility, cooking properties of collagen and microstructure, were determined. All measurements were made with two replicates. The comparative analysis of the experimental results for high-quality beef with different marbling degree was carried out

The presented data indicate that fat content of 7.4 to 9.2% corresponds to the marbling degree of 3 (good) and 4 (intense) according to the Russian standard. It was established in the research performed previously by [1] : a high positive correlation (r=0.80) exists between the content of oxyproline, the quantity of connective tissue proteins, strength characteristics of raw meat (shear force) and fat content. At the same time, the dependence between the degree of mechanical strength reduction upon cooking and cooking properties of collagen is low. These regularities are also observed in the present experiment.

These regularities can be explained by the fact that the adipose tissue is a variant of loose connective tissue, which is formed by a network of loosely located collagen fibers. Dense connective tissue (fasciae, tendons) is characterized by strong development of the intercellular substance and represented by dense bundles of collagen fibers including elastic fibers. Thus, the content of the adipose and connective tissues in meat and, respectively, the ratio of the amount of dense tissue to the amount of loose tissue determine meat tenderness.

Breed ---------- Indicators	Aberdeen Angus steers, marbling 3	Aberdeen Angus steers, marbling 4
Moisture, %	70.3	69.4
Fat, %	7.4	9.2
Protein, %	21.25	20.25
Color indicators		
L	38.0	40.4
a	20.5	20.4
b	13.2	15.8
in vitro digestibility, mg of tyrosine /g of protein (pepsin)	8.4	8.4
in vitro digestibility, mg of tyrosine /g of protein (trypsin)	11.2	11.0
Total digestibility	19.6	19.4
oxyproline, mg	84.0± 1.5	91.0±1.9
connective tissue proteins, %	0.68	0.73
Content of tryptophan, mg %	469±2.1	456±2.6
Protein-quality indicator (PQI)	5.58	5.01
Moisture holding capacity, %	58.81	59.33

Table 1 : proximate analysis

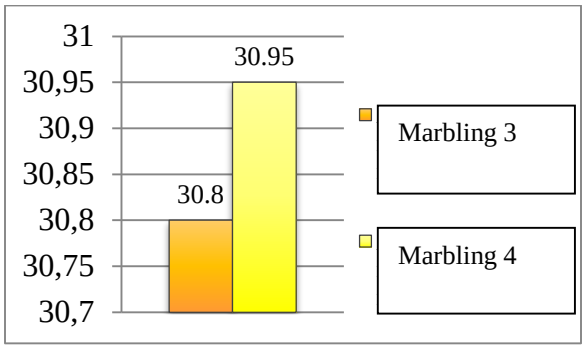

Figure 1. Cooking properties of collagen, %

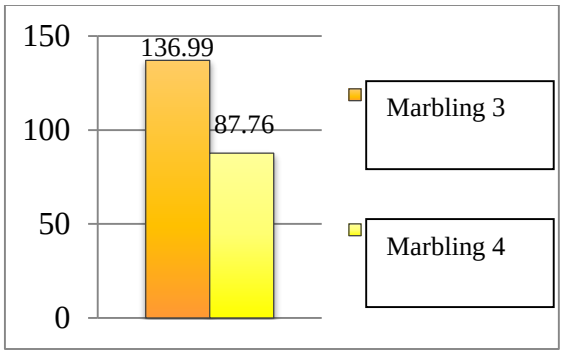

Figure 2. Shear force, N/m^2

No significant difference was found in vitamin content and degree of digestibility *in vitro* between the samples with different marbling.

Table 2 presents the data on the amino acid composition of L.dorsi with different degree of marbling. Analysis of these data demonstrates that L.dorsi with marbling 4 has slightly less amino acids including essential than L.dorsi with marbling 3.

Amino acid content %	*Longissimus dorsi*		
	marbling 3	marbling 4	Mean values
Total	20.662	19.691	20.177
Including essential	7.963	7.587	7.775

Table 2: total and essential amino acid contents

Fatty acid composition of the lipid fraction is an important indicator, on which basis it is possible to judge the biological value of meat.

Analysis of the data on the fatty acid composition shows that fats in the analyzed samples are very close in composition. Assessment of ω6/ω3 ratio calculated by the main fatty acids with consideration for ω3 fatty acids content shows that the value of ω6/ω3 in the conditions of the experiment was 11.3 for the samples with lower fat content (7.4%) and 11.5 for the samples with higher fat content (9.2%). According to [6] the indicator of ω6/ω3 ratio is given at the level of 6/14.

Microstructure on the cross section of L.dorsi of Aberdeen Angus steers with the marbling degree of 3 (Fig. 3) and the marbling degree of 4 (Fig. 4) indicates that the beef samples with different degree of marbling have similar microstructural

characteristics; the degree of adipose tissue development in the sample with marbling 4 is higher than in the sample with marbling 3. These data is also confirmed by the international research [7].

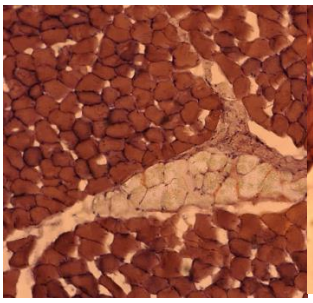

Figure 3.

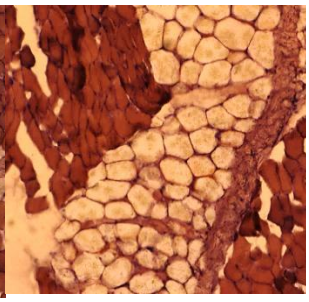

Figure 4.

IV. CONCLUSION

The degree of beef marbling determines its structural and mechanical and sensorial properties. A positive correlation between the degree of marbling, intramuscular fat content and cooking properties of collagen and an inverse correlation with the structural and mechanical properties (toughness) of raw meat were established.

An insignificant reduction in amino acid content and slightly higher ω6/ω3 ratio in beef with higher degree of marbling was observed.

The differences in microstructure of the beef samples with different degree of marbling were established only in the degree of adipose tissue development.

ACKNOWLEDGEMENTS

The authors thank LLC "Bryansk meat company" and personally the chief technologist Denis Valerievich Popov.

REFERENCES

1. Lisitsyn, A. B., Sus, I.V., Mittelstein, T. M. et al. (2010). Principles of classification and assessment of quality in the new unified national standard "Cattle for slaughter, beef and veal in carcasses, half-carcasses and quarter carcasses". All about meat 3: 39-43.
2. Sus, I.V., Mittelstein, T. M., Kozirev, I. V. (2012). High-quality beef – a new product in the Russian market.
3. Lisitsyn, A. B., Sus, I.V., Mittelstein, T. M. (2012). Meat of the European style. Methods of complience assessment 2: 8-9.
4. Tatulov, Yu. V., Sus, I.V., Mittelstein, T. M., Bulychev, I.N. (2010). Quality assessment of beef cuts and individual muscles relative to m. Longissimus dorsi.
5. Lisitsyn, A.B., Shumkova, I.A. (2002). Fatty acids. Value for meat quality and human nutrition. A review. Moscow: VNIIMP.
6. J. J. Grigera Naon, A. Schor, et. al. (2007). Relationship between short term energy supplementation and meat quality of steers in Argentina. In Proceedings 53th ICoMST (International Congress of Meat Science and Technology) Beijing, China.
7. Veiseth-Kent, E, Hollung, K., Ofstad, R, Aass, L.B, Hildrum, K.I. (2010). Relationship between muscle microstructure, the calpain system, and shear force in bovine longissimus dorsi muscle. J Anim Sci. 88(10):3445-51.