Amino acid composition of beef obtained from the specialized meat cattle

E Alekseeva and V Kolchina

Department of Biotechnology, Kurgan State Academy of Agriculture named after T S Maltsev, Kurgan region, Ketovsky district, the village of Lesnikovo, 641300, Kurgan, Russia

E-mail: AlekseevaElena@yandex.ru

Abstract. The article presents the study results of the amino acid composition of beef obtained from young Aberdeen-Angus and Hereford breeds. It has been established that meat is a complete amino acid product. At the same time, the protein quality indicator of beef obtained from the young of Aberdeen-Angus and Hereford breeds of the age of 12 months was 5.55 and 5.34, and from the bulls of the age of 18 months - 5.73 and 5.49, the methionine: tryptophan ratio – 1.22 and 1.23. The youngsters of the age of 18 months of the studied breeds have the same content of aspartic acid in meat, it is 2.03 g/100 g. A comparative analysis of the concentration of essential amino acids in beef showed that there was more of valine, histidine(-amino-5-imidazole propionic acid), lysine, threonine and phenylalanine in the bullheads of Hereford, than the peers of Aberdeen-Angus breed by 3.30, 4.26, 1.11, 7.14 (P> 0.05), and 4.76%, respectively. The concentrations of valine, isoleucine, methionine and tryptophan were higher in Aberdeen-Angus than in Hereford by 3.30, 2.50, 2.00 and 2.50%, respectively. Analyzing the study results of beef on the content of replaceable amino acids in bulls of the age of 18 months, the advantage in concentration of alanine, glycine, glutamic acid, serine, tyrosine, cystine was on the side of Aberdeen-Angus breed, the difference with peers of Hereford breed was 6.50 (P> 0.05), 2.25, 8.28 (P> 0.05), 56.72 (P> 0.001), 1.10 and 9.09 (P> 0.05)% respectively, and the quantity of solid eutectoid inclusions based on electron compound Cu3Sn6.

1. Introduction

The country's agro-industrial complex faces a strategically important task. It is an increase in the production of high-quality meat, including beef [1-4]. One of the ways to solve this problem is to create a specialized beef cattle industry [5, 6]. In recent years, there have been positive trends in Russia in providing the population with meat of domestic production and meat products in general, but there is a steady negative trend in beef – the level of self-sufficiency in beef decreased from 51.7 to 45.6 %. The development of the beef cattle industry in the Kurgan Region is a promising direction for solving the region's economic and social problems, the possibility of a breakthrough in the economy and, as a result, improving the quality of population life. There are all conditions for the development of this industry in the region. They are natural forage lands, the possibility of using low-cost intensive pasture technology, resources of breeding stock in dairy herds for the formation of new meat farms, feeder grain [7; 8].

The nutritional value of meat, including beef, is determined by the content of nutrients needed by the human body [9-15]. The value of meat as a protein product is determined primarily by the balanced composition of amino acids. The average amino acid composition of beef proteins in its biological value
Amino acids are chemical compounds from which all proteins of any living organism are synthesized. Their distinctive feature is the fact that they are 15% composed of nitrogen atoms. The importance of amino acids for the body is difficult to overestimate, because any cell membrane, no matter what organ was not discussed, 80% consists of proteins and only 20% of fat. Amino acids are divided into essential (valine, leucine, isoleucine, threonine, methionine, phenylalanine, tryptophan, lysine), partially interchangeable (arginine and histidine) and interchangeable (alanine, asparagine, aspartic acid, glycine (glycocol), glutamine, glutamic acid, proline, serine, tyrosine, cystine). Essential amino acids are not synthesized in the human body, but are necessary for its normal functioning. They have to be ingested with food. With a lack of essential amino acids delayed growth and development of the body. Interchangeable amino acids are synthesized in the human body. For humans, the main source of amino acids are foods rich in protein.

2. Materials and methods

The aim of our study was to determine the amino acid composition of meat of young Aberdeen-Angus and Hereford breeds of different ages.

Studies were conducted on Aberdeen-Angus and Hereford bulls of the age of 12 and 18 months. Animals in groups are selected by the method of balanced groups-analogs in age and live weight. Each group had 3 heads. To determine the amino acid composition of the meat of the whole soul, a complete deboning of one half carcass was carried out. Then, the meat obtained after veneering was passed through a top, mixed in a mince mixer. Samples for analysis were selected by the quartering. The content of amino acids was determined in the average sample of meat by high performance liquid chromatography.

Biometric processing of the experimental data was performed using Excel software and electronic online calculator (www.math.semestr.ru).

3. The study of the structure of the modified lead-tin-base bronze

The results of the study of beef obtained from the bulls of Aberdeen-Angus breed are presented in table 1.

The meat of bulls of the age of 18 months compared with animals of 12 months has a higher content of the following essential amino acids is noted: valine - by 6.82% (P > 0.05), leucine - by 3.60%, isoleucine and phenylalanine - by 1.25%. The concentration of lysine, methionine, tryptophan was the same - 1.78, 0.50 and 0.41 g / 100 meat, respectively.

The bulls of the age of 12 months have a greater content of histidine and threonine by 1.10%.

The meat of 18 months calves contains more than alanine by 1.63%, aspartic acid - by 1.97%, glycine - by 3.37%, serine - by 5.00%, tyrosine - by 2.20%, A greater amount of glutamic acid, hydroxyproline, arginine was detected in the meat of 12-month-old young animals, the difference was 2.36, 2.74 and 2.56%, respectively. The concentration of cystine was the same, it is 0.22 g / 100 g of meat.

The simplest and most common method for determining the protein nutritional value of meat is based on the determining the content of only two amino acids: tryptophan as an amino acid, which characterizes the content of high-grade proteins, and hydroxyproline as an amino acid, which characterizes the content of defective proteins. The ratio of tryptophan: hydroxyproline is called the protein quality indicator (BCP), decreases with the increasing content of connective tissue proteins in meat and, therefore, is associated with the decrease in the nutritional value of meat.

In our studies, it was established that the BCP of meat obtained from the young of the age of 12 months was 5.55, and from the bull-calves of the age of 18 months - 5.73, the difference was 3.14%.
The ratio of methionine-tryptophan allows you to evaluate the product according to its importance in the diet. Normally, this ratio is 1. The higher the value of this indicator, the more profitable it is to include this product in the diet to improve the balance in amino acid composition. The studies revealed that this indicator in the meat of bulls of both age groups was 1.22.

Thus, meat obtained from Aberdeen-Angus breed bulls of different ages is a complete amino acid product, which confirms the value of the protein quality indicator - 5.55-5.73 and the ratio methionine-tryptophan is 1.22.

The results of the study of beef obtained from bulls Hereford breed are presented in Table 2.

In the meat of bulls of the age of 18 months compared with the animals of the age of 12 months has a higher content of the following essential amino acids: histidine – by 3.19%, leucine – by 5.22% (P > 0.05), phenylalanine – by 3.57%. The concentrations of methionine and tryptophan were the same - 0.49 and 0.40 g / 100 of meat, respectively. bulls of the age of 12-month-old have a higher content of valine, isoleucine, lysine and threonine by 8.08 (P > 0.05), 1.27, 1.10 and 1.01%, respectively.

The meat of bulls of the age of 18 months contained more aspartic acid by 1.48%, glycine by 1.15, glutamic acid by 2.26, and tyrosine by 4.44%. The same amount of alanine in the studied samples was found, it was 1.15 g / 100 g, serine – 0.39, arginine – 1.65, cystine – 0.20 g/100 g. the meat of bulls of the age of 12-month young animals have more oxyproline – 0.075 g/100 g, the difference was 2.67%. Protein quality indicator of beef was higher in young animals of 18 months-old and amounted to 5.49, the difference with bulls of 12 months-old was 2.73%.

The ratio of the content of amino acids methionine: tryptophan in meat of bulls of both age groups was 1.23.

Thus, meat obtained from the young of Hereford breed of the age of 12 and 18 months is a complete amino acid composition of the product, this is confirmed by the value of the protein quality indicator - 5.34-5.49 and the methionine: tryptophan ratio – 1.23.

The 12-month-old bulls of Hereford breed, analyzing meat for the content of essential amino acids, have a higher content than peers of Aberdeen-Angus breed, valine, lysine, threonine and phenylalanine, it is by 17.17, 2.20, 7.07 (P > 0.05) and 2.47%, respectively. The concentrations of leucine, methionine,
and tryptophan were higher in Aberdeen-Angus than in the Hereford, by 5.22, 2.00, and 2.44%, respectively. According to the content of histidine and isoleucine in beef, there were no differences between the analyzed groups of animals of the age of 12 months.

### Table 2. Content of amino acids in the meat of Hereford steers of different ages, g/100 g

| Indicator         | 12 months    | 18 months    |
|-------------------|--------------|--------------|
|                   | $\bar{X} \pm S_{\bar{X}}$ | $\bar{X} \pm S_{\bar{X}}$ | $CV, \%$ | $CV, \%$ |
| Valine            | 0.99±0.06    | 0.91±0.05    | 9.95  | 9.95  |
| Histidine         | 0.91±0.01    | 0.94±0.03    | 2.20  | 5.05  |
| Leucine           | 1.27±0.02    | 1.34±0.05    | 2.76  | 5.83  |
| Isoleucine        | 0.79±0.01    | 0.78±0.02    | 1.93  | 3.39  |
| Lysine            | 1.82±0.07    | 1.80±0.01    | 6.57  | 1.11  |
| Threonine         | 0.99±0.06    | 0.98±0.02    | 10.15 | 3.85  |
| Phenylalanine     | 0.81±0.04    | 0.84±0.03    | 8.90  | 6.58  |
| Methionine        | 0.49±0.01    | 0.49±0.02    | 3.14  | 7.22  |
| Tryptophan        | 0.40±0.02    | 0.40±0.01    | 7.50  | 5.00  |
| Alanine           | 1.15±0.03    | 1.15±0.04    | 4.35  | 5.29  |
| Aspartic acid     | 2.00±0.07    | 2.03±0.04    | 5.89  | 3.13  |
| Glycine           | 0.86±0.04    | 0.87±0.03    | 8.37  | 5.16  |
| Glutamic acid     | 2.60±0.12    | 2.66±0.03    | 7.91  | 1.77  |
| Serine            | 0.39±0.02    | 0.39±0.01    | 8.31  | 3.88  |
| Tyrosine          | 0.86±0.02    | 0.90±0.01    | 4.68  | 1.11  |
| Hydroxyproline    | 0.075±0.001  | 0.073±0.002  | 1.33  | 5.97  |
| Arginine          | 1.65±0.03    | 1.65±0.03    | 2.79  | 2.79  |
| Cystine           | 0.20±0.01    | 0.20±0.01    | 7.77  | 7.77  |
| BCP               | 5.34±0.25    | 5.49±0.23    | 8.18  | 7.24  |

Analyzing the results of studies of beef on the content of replaceable amino acids that 12 months old bulls have, the advantage on the concentration of alanine, glutamic acid, serine, tyrosine and cystine was on the side of Aberdeen-Angus breed, the difference with peers of Hereford breed was 4.96, 12.46 (P> 0.05), 3.37 and 9.09% (P> 0.05), respectively. The index of protein value of beef was higher in Aberdeen-Angus by 3.78%. The difference in the ratio of methionine: tryptophan was 0.81% in favor of Herefords.

In youngers of age of 18 months of the studied breeds, the same content of aspartic acid in meat was found – 2.03 g/100 g. A comparative analysis of the concentration of essential amino acids in beef showed that hereford bulls had more valine, histidine, lysine, threonine and phenylalanine, than peers of Aberdeen-Angus breed, by 3.30, 4.26, 1.11, 7.14 (P> 0.05), and 4.76%, respectively. The concentrations of valine, isoleucine, methionine and tryptophan were higher in Aberdeen-Angus than in Hereford, by 3.30, 2.50, 2.00 and 2.50%, respectively.

Analyzing the results of beef studies on the content of replaceable amino acids in the meat of bulls of the age of18 months the advantage in the concentration of alanine, glycine, glutamic acid, serine, tyrosine, cystine was on the side of the Aberdeen-Angus breed, the difference with peers of Hereford breed was 6.50 (P> 0.05), 2.25, 8.28 (P> 0.05), 56.72 (P> 0.001), 1.10 and 9.09% (P> 0.05), respectively. Aberdeen-Angus have higher protein value of beef, it was by 5.11%. The difference in the ratio of methionine: tryptophan was 0.81% in favor of the herefords.

Single-factor dispersion method of analysis established the strength of the influence of factors "breed" and "age" on the content of tryptophan and hydroxyproline in the meat of bulls specialized meat breeds. Thus, the strength of the influence of the breed factor on the tryptophan concentration at 12-month age was 3.47 %, at 18-month – 5.04 %. The strength of the influence of the same factor on the content of oxyproline in the considered age periods was 16.00 and 8.57 %, respectively. The influence
of age factor on the concentration of oxyproline was found in bulls Aberdeen-Angus breed 15.09 %, young Hereford – 13.04 %.

4. Conclusion
Thus, beef meat obtained from Aberdeen-Angus and Hereford bulls of different ages is a complete amino-acid product, as it is evidenced by the protein quality value of 5.55-5.73 and 5.34-5.49, the ratio of methionine: tryptophan is 1.22 and 1.23.

The 12-month-old bulls have higher indicator of the protein value of beef, it was by 3.78% for Aberdeen-Angus breed than for Hereford. The difference in the ratio of methionine: tryptophan was 0.81% in favor of the Herefords.

The 18-month-old bulls also have higher protein value of beef in Aberdeen-Angus, it was by 5.11% than in the Hereford. The difference in the ratio of methionine: tryptophan was 0.81% in favor of the Herefords.

The strength of the influence of the age factor on the concentration of oxyproline was found in bulls Aberdeen-Angus breed 15.09 %, young Hereford – 13.04 %.

References
[1] Chasovshchikova M A 2017 Relationship between the genetic variants of kappa-casein and prolactin and the productive-biological characteristics of cows of the black-motley breed, J. of Pharmaceutical Sci. and Res. 9(7) 1038–1044
[2] Donnik I M 2017 Productivity and health markers for large cattle, Int. J. of Green Pharmacy 11(S3) S620-S625
[3] Garkovenko A V 2018 Polymorphism of cattle microsatellite complexes, J. of Pharmaceutical Sci. and Res. 10(6) 1545–1551
[4] Koshchaev A G 2016 Amino acid profile of meat of specialized beef breeds. Res. J. of Pharmaceutical, Biological and Chemical Sci. 7(5) 670–676
[5] Plutakhin G A, Koshchaev A G, Donnik I M 2016 Quality assessment of chicken meat by analysis-of-variance method Res. J. of Pharmaceutical, Biological and Chem. Sci. 7(3) 2293-2299
[6] Sukhanova S F 2018 Productive qualities of cattle depending on the breed, The Turkish Online J. of Design, Art and Communic. Spec. Ed. 419–427
[7] Amerkhanov Kh A 2017 The project Concepts of sustainable development of beef cattle in the Russian Federation until 2030. Bulletin of Beef Cattle 97(1) 7-12
[8] Koschayev A G, Shuklin S Yu, Schukina I V 2017 Genetic diversity of cattle bred in the Krasnodar Territory Agrarian Bulletin of Urals 166(12) 5
[9] Kulintsev V V 2018 Efficiency of growing and fattening bulls of Aberdeen Angus breed at different intensity of beef production News of Orenburg State Agrarian University 72(4) 278-280
[10] Tyulebaev S D 2017 The state of allelic forms of the capn1, cast genes and compatibility of different lines in the population of the Bredinsky meat type of Simmentals Bulletin of Beef Cattle Breeding. 98(2) 52-57
[11] Sheveleva O M 2018 The results of the use of breed resources of cattle in the production of beef in the Tyumen Region Bulletin of the AIC of Stavropol 30(2) 97-101
[12] Sheveleva O M 2017 Meat cattle breeding of the Tyumen Region. World of Innovations. 1 112-117
[13] Schukina I V 2014 Meat cattle breeding of the Krasnodar Territory Bulletin of Bashkir State Agrarian University 29(1) 62-64
[14] Schukina I V 2013 Energy and nutritional value of meat bulls of Aberdeen Angus and Hereford breeds *Proceedings of Kuban State Agrarian University* **43** 198-199

[15] Sukhanova S, Alekseeva E, Lushnikov N, Nazarchenko O 2018 Productivity of Young Aberdeen Angus and Hereford Breeds *Int. Sci. and Practical Conf. "AgroSMART - Smart solutions for agriculture"* (AgroSMART 2018) pp.24-28