Muscular tissue of steers and rams grown in conditions of arid pastures: analysis of microelement composition

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Abstract. The article presents the analysis of raw material for the production of radioprotective meat products. The analysis of the composition of the farm animals’ muscle tissue with respect to the microelement content has been performed. There have been presented analysis results of the muscle tissue samples of Edilbay rams and Kazakh white-headed steers grown under similar conditions and grazed on the same pastures of the Volgograd-Edilbay breeding center in the Bykovsky rayon, the Volgograd region. The muscle tissue of cattle, in particular, steers of the Kazakh white-headed breed, has been established to have higher contents of iodine, iron and selenium by the end of the livestock growing period. The tissue has been also found to be predispositioned to the accumulation of essential microelements under consideration; so, this tissue has been concluded to be recommended as an ingredient for the formulations of meat products being developed.

Keywords: arid pastures, bull-calves and rams of meat breeds, microelement composition, raw meat.

1. Introduction

About 2 billion people in the world live in conditions of natural iodine deficiency [1]. Despite the efforts of the international community, iodine deficiency remains a pressing medical and social problem in many countries [2]. As evidenced in practice, salt iodization is not enough to replenish the iodine deficiency of the population [3 and 4]. According to the WHO, disorders caused by this type of micronutrient deficiency are the most common non-communicable diseases, both in the Russian Federation and in the world [5].

The main factor that causes the iodine deficiency is the inadequate availability of this trace element in nature, so its content in most food products is very low. At the same time, seafood is almost the only source of iodine in human nutrition [8].

Through thyroid hormones, iodine is involved in the growth and differentiation of cells, as well as metabolism of all kinds. That is why the iodine deficiency can lead to numerous negative consequences [7]. Permanent iodine deficiency contributes to increased absorption of iodides from the circulating...
blood by the thyroid gland. Therefore, the governments of many states are taking special measures to address the iodine deficiency problem in areas where environmental conditions have a tendency to worsen [8, 9].

One of the largest areas of animal husbandry in our country is the south of Russia that unites the North Caucasus and Southern Federal Districts. This is facilitated by vast pastures; their area in the Southern Federal District is 12.5 million hectares and in the North Caucasus Federal District, 5.3 million hectares [6]. In this regard, a comprehensive study of the conversion of nutrients in various feed conditions is not only of scientific, but also of industrial interest.

The purpose is to analyze the ability of muscle tissue of experimental animals to accumulate trace elements.

2. Materials and methods
The research studies were performed under the conditions of the selection and genetic center OOO “Volgograd-Edilbay” in the Bykovsky rayon, the Volgograd region. The experiment was conducted on Edilbay rams and Kazakh white-headed steers at the age of from birth to 8 and 17 months, respectively. The animals were kept under similar conditions in grazing system. The slaughter of experimental steers was carried out at the slaughter station of the OOO Volgograd-Edilbay.

Sampling of meat was performed according to GOST 51447-99. The analysis of the trace elements content was performed by the inductively coupled plasma mass spectrometry on the OPTIMA-2000DV device (PerkinElmer, USA) in the laboratory of the autonomous non-profit organization “Center for Biotic Medicine,” Moscow, according to the Skalny’s method. The Var-TS-Ms and IV-ICPMS-71A solutions (InorganicVentures, USA) were used as standards. The experimental results obtained were processed by modern methods of mathematical processing using Microsoft Office software and Statistica.

3. Research results and discussion
According to the analysis of literature and patent sources, it is selenium and iron that can substantially affect the synthesis of iodine-containing hormones and the thyroid gland. Pork meat, despite its widespread use in the food industry, was not considered in our research, since it is well known to have high content of adipose tissue compared with another type of raw meat and contain practically no essential trace elements, including those considered. The studies conducted before noted a low content of iron and selenium in chicken meat [10 and 11]. Therefore, it also was not studied in our research.

In this regard, to achieve the purpose of the work, it was decided to grow steers of the Kazakh white-headed breed and rams of the Edilbay breed in similar conditions of grazing on the same territory, as well as study the meat raw materials obtained from them in terms of accumulation of the microelements above-mentioned.

The study of the nutritional value and chemical composition of the components of the actual diet of experimental animals showed that the content of nutrients, in particular macro- and microelements, in the composition of the main feeding herbs allowed keeping animals of high productivity (table 1).

On the basis of the given data it is possible to draw a conclusion about rather high content in plants of arid pastures of essential micro-and macronutrients and their prospects as a forage resource. To study the volume of accumulation of these nutrients was conducted nutrient analysis. The results of this analysis are shown in the tables 2-3.
Table 1. Macro- and microelements composition of pasture vegetation of arid territories of the Trans-Volga region (in 1 g of dry matter)

| Plant                        | Micronutrients, mg | Macronutrients, g |
|-----------------------------|-------------------|-------------------|
|                             | Fe    | Mn    | Zn    | Cu    | Mg    | Ca    | P    | K    | S    |
| Agropyron glaucum           | 84.0  | 90.1  | 25.0  | 3.5   | 0.9   | 1.0   | 0.6  | 5.4  | 0.4  |
| Agropyrum tenerum           | 84.0  | 95.1  | 25.0  | 4.5   | 1.0   | 1.3   | 0.6  | 6.3  | 0.5  |
| Medicago falcata            | 208.0 | 41.2  | 27.7  | 10.5  | 3.8   | 5.8   | 0.4  | 2.9  | 0.5  |
| Vicia cracca                | 154.0 | 41.2  | 17.5  | 6.5   | 2.5   | 2.9   | 0.3  | 3.1  | 0.2  |
| Onobrychis arenaria         | 136.0 | 53.9  | 30.0  | 9.0   | 2.6   | 2.0   | 0.5  | 3.8  | 0.3  |
| Galéga orientális Lam.      | 128.0 | 35.6  | 43.3  | 11.5  | 2.8   | 2.5   | 0.5  | 5.2  | 0.3  |
| Stipa lessingiana           | 170.0 | 49.1  | 17.5  | 3.0   | 0.4   | 1.2   | 0.2  | 2.6  | 0.4  |
| Astragálus cicer            | 190.0 | 32.2  | 25.0  | 6.0   | 2.3   | 1.1   | 0.1  | 1.5  | 0.2  |
| Agropyron fragile           | 75.0  | 41.2  | 22.5  | 4.5   | 0.7   | 2.2   | 1.2  | 7.7  | 0.7  |
| Salsola ruthenica Iljin     | 428.0 | 67.0  | 20.2  | 5.4   | 5.3   | 4.9   | 1.1  | 16.3 | 0.7  |
| Camphorosma lessingii       | 470.0 | 34.9  | 16.5  | 1.6   | 1.3   | 5.4   | 1.1  | 10.4 | 0.5  |
| Artemisia lercehana         | 211.0 | 62.5  | 12.8  | 7.2   | 1.7   | 4.8   | 1.6  | 10.2 | 1.3  |
| Artemisia austriaica        | 190.0 | 38.0  | 16.5  | 6.3   | 1.4   | 4.9   | 1.6  | 10.0 | 0.8  |
| Kochia prostrata            | 199.0 | 71.5  | 11.8  | 4.5   | 4.4   | 5.7   | 1.0  | 6.4  | 0.5  |

Table 2. Concentration of trace elements in the muscle tissue of rams, mg/kg (m·102)

| Element | Measured values | Sample I | Sample II | Sample III | Sample IV | Sample V | M  |
|---------|-----------------|----------|-----------|------------|-----------|----------|----|
| Fe      | 2.8             | 3.1      | 2.9       | 2.9        | 3.1       | 3.1      | 3.1 | 2.9 | 3.0|
| Se      | 19.6            | 20.6     | 19.8      | 19.1       | 20.8      | 20.9     | 18.9 | 19.1 | 20.5 | 20.1 | 20.1 | 19.1 | 20.8 | 19.9 |
| Fe      | 1944            | 1941     | 1801      | 1860       | 1998      | 1860     | 1938 | 1807 | 1945 | 1923 | 1820 | 1972 | 1970 | 1978 | 1852 | 1907 |

Table 3. Concentration of trace elements in the muscle tissue of steers, mg/kg (m·102)

| Element | Measured values | Sample I | Sample II | Sample III | Sample IV | Sample V | M  |
|---------|-----------------|----------|-----------|------------|-----------|----------|----|
| Fe      | 3.8             | 4.2      | 4.0       | 3.9        | 4.1       | 3.9      | 4.1 | 4.2 | 3.9 | 4.1 | 4.2 | 3.8 | 4.0 |
| Se      | 35.4            | 38.7     | 36.6      | 36.2       | 38.2      | 36.2     | 37.4 | 34.8 | 38.6 | 35.8 | 38.9 | 35.7 | 37.6 | 38.5 | 34.9 | 36.9 |
| Fe      | 2218            | 2424     | 2292      | 2271       | 2394      | 2271     | 2366 | 2206 | 2421 | 2348 | 2223 | 2408 | 2406 | 2415 | 2139 | 2320 |

The data obtained indicated a considerably higher content of all the trace elements analyzed in beef samples compared with the lamb ones. This can be explained by a genetic predisposition of the steers’ muscle tissue to the accumulation of the trace elements studied.

4. Conclusion

Thus, we can conclude about good prospects of meat raw materials from animals of the breeds under study, as well as of further research and development of meat products based on the raw materials from them.

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