Nutritional value and chemical composition of meat from rabbits of different purpose of production

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Abstract

The study aimed to evaluate the nutritional value and chemical composition of rabbit meat and analyze the differences in meat parameters within experimental groups and breeds. The article presents the results of meat parameters evaluation of samples, obtained from *M. longissimus dorsi* muscle and minced cuts, from rabbits of Thermon (meat production) and Belgian Hare (meat/fur production) breeds. The rabbits were slaughtered at age of 120 days and divided into three experimental groups by different energy values of feed. The first group was given low-compound feed with 11.6 MJ/kg dry matter, the second group got feed with 11.8 MJ/kg dry matter and the third group – 12.1 MJ/kg dry matter. Meat samples from *M. longissimus dorsi* and minced cuts had parameters within normal meat quality. The different calories content among the three feed groups (I, II, III) was accompanied by changes in parameters within groups and the breeds. There was a certain tendency of the III group to have a higher caloric value and certain parameters (ash, fat, protein), in comparison to the I group within one breed. Though, there were no certain correlations between I and II groups, when the same parameters were fluctuating depending on the meat sample (minced or from the muscle) and the breed.

Key words: nutritional value of meat; chemical composition of meat; low-compound feed; rabbits; Thermon rabbit breed; Belgian Hare rabbit breed

Introduction

Rabbit breeding is one of the promising branches of animal husbandry, the main task is the provision of the population with healthy dietary meat, fur and fluff. The global variety of rabbit breeds reflects the breadth of the rabbit's unique qualities. (Hernandez and Dalle Zotte, 2010).

Rabbit meat is a valuable dietary product that contains optimal caloric value and high content of easily digestible proteins (Andrade et al., 2018). In terms of chemical, morphological and technological qualities, rabbit meat has several advantages over the meat of other animals. Rabbit proteins are digested in humans by 90%, while beef by 62%. Cholesterol content in rabbit meat is 2.4–2.7 times less than in chicken and veal. Therefore, rabbit meat is considered to have a high-value as a dietary product (Trocino et al., 2018; Sokolova et al., 2017).

The nutritional value of rabbit meat is high as it is lean, rich in proteins of high biological value and high in linolenic acid. The meat of young rabbits contains relatively much moisture (73.9–77.0%), a moderate amount of protein (14.6–19.1%), fat (4.1–6.3%) and minerals (1.0–1.1%) and also has a

relatively low caloric value (134–166 kcal/100 g). With age, the content of protein, fat, minerals and caloric value increases in rabbit meat. Chemical composition of meat largely depends on the age and breed, the purpose of production, the level of nutrient content and metabolic energy in it. The pH of meat depends on genotype, sex, age, weight, type of feeding and technological conditions of keeping the animals (Barron et al., 2005; Simonova et al., 2010). Rabbit meat is tasty and easy to digest, with high nutritional and dietary properties: meat contains 20–21% protein, unsaturated fatty acids – 60% (of total fatty acids) and has low concentrations of fat, cholesterol, sodium and rich in potassium, magnesium, phosphorus (Cullere and Dalle Zotte, 2018).

The quality of meat can be additionally qualified by chemical composition. It allows evaluating its nutritional value, age, breed differences, as well as changes that occur under the influence of feeding and housing conditions. The most important parameters of chemical composition of meat are the moisture, fat, protein and ash content. The concentration value of mentioned parameters determines the nutritional value of meat. The best in terms of digestibility and nutrition is meat, the dry matter of which contains an equal ratio of protein and fat content (Trocino et al., 2018; Zepeda-Bastida et al., 2019), the largest ratio of protein / intramuscular fat occurs at the time of slaughter at 60–90–120 days and is respectively 5.3 : 1; 4.0 : 1; 3.0 : 1. It was found (Wang et al., 2016) that the age of rabbits affected the content of amino acids and biological value of meat protein.

In rabbits' production facilities, depending on the conditions of rabbits and their food supply, different methods of feeding are used: combined (or mixed) with the use of concentrated, green, succulent, coarse, wild grass, tree branches; feeding with the use of loose and granular complete feed (Gasco et al., 2019; Miteva et al., 2020).

Material and Methods

The study was conducted on 30 rabbits of the Thermon breed and 30 rabbits of the Belgian Hare breed. Rabbits were divided into three experimental groups, with 10 rabbits in each group. Rabbits were slaughtered at 120 days and fed with different feed from 46 days. The animals were fed with low-component compound feed barley grain, soybean and hay flour. The ratio of feed components (% by weight): Group I: barley – 70, soybeans – 20, hay flour – 10; Group II: barley – 60, soybeans – 30, hay flour – 10; Group III: barley – 50, soybeans – 40, hay flour – 10. The grain feed was extruded. 1 kg dry matter contained: I – 11.6 MJ, II – 11.9 MJ, III – 12.1 MJ, respectively.

The experiment was performed based on the breeding facility of the Institute of Animal Science of NAAS and in the Test Center for quality assessment of feed and products of animal origin, licensed by ISO / IEC 1725: 2006.

Control slaughter of experimental animals was done in the meat-processing shop of the farm. Animals were stunned by electronarcosis (90 V for 5 s), immediately hung by the hind legs in the processing line and quickly bled out by cutting the jugular veins and the carotid arteries. After the bleeding, out the longest back muscle (*m. longissimus dorsi*) and *musculus longissimus dorsi* (for minced meat samples) muscles were separated by removing the skin, fat, and connective tissue, chilled and stored for 24 h at 4 °C until physicochemical analysis.

The pH was registered by portable digital LF-Meter "LF-Star CPU-Pistole". The moisture in the meat was determined while drying it at 105 °C till the establishment of permanent weight. The protein content was analyzed by Kjeldahl's method. The moisture-retaining capacity of meat was found by the pressing method. The moisture content of meat samples was measured by oven drying 2 g of meat at 105 °C/24 hours until a persistent weight result. Fat from meat samples was determined with the Soxhlet extraction method using petroleum ether. Ash content was obtained by igniting 2 g of meat samples in a muffle furnace set at 570 °C for 4–6 h depending on the samples. Based on the data of chemical analysis of meat, its caloric value was calculated.

The effect of the different feeding energy value on the meat quality parameters was calculat-

ed using the one-way ANOVA of SAS (JMP12 program), when the p value ≤ 0.05 was considered significant.

Results and Discussion

According to Table 1, the mean ash content in the samples of the II group was significantly higher in comparison to the I and III groups by 34.7% and 35.3% respectively within the Belgian Hare rabbit breed.

The minced samples of the I and III group tended to have higher moisture holding capacity in comparison to II by 5.7 and 6.4%. Also, there was a slight tendency of III group meat samples to have a slightly higher caloric value by about 2% and a tendency of higher protein content by about 4%.

The compared groups did not differ in moisture, dry matter content, fat and protein. The concentration of protein and fat was within mean values, about 18% and 9% respectively. Due to no significant difference in fat and protein content in the minced samples, there was difference for the caloric value for all groups. The ratio of protein to fat content was 2 : 1.

The pH of rabbit meat might be affected by many aspects, for instance by housing conditions, feeding, breed, carcass cooling rate and handling (Daszkiewicz and Gugołek, 2020). At the current research moisture holding capacity and the pH of the tested samples didn't differ among the group and were within normal meat quality parameters.

According to Table 2, the increase in dry matter of minced rabbit meat of Thermon breed had a significant difference in fat content among the groups ($p \leq 0.05$). Meat samples of the III experimental group had significantly higher fat content by 7.2% for the I group and 16.2% for the II group, respectively, ($p \leq 0.05$).

The protein content was slightly higher in rabbits of the II group in comparison to I and III experimental groups by 2.5% and 4.7%, respectively.

An increase in fat content caused a higher energetic value in the III group of meat samples in comparison to I and II groups, respectively. It could be caused by a higher calorie level of feed for the III group (12.1 MJ).

Comparing different minced samples from rabbits of Thermon and Belgian Hare breeds (Tables 1, 2), the calories value of meat samples of Thermon was higher by 26.2% ($p \leq 0.01$) in comparison to the Belgian Hare. Due to significant difference in caloric value, Thermon meat samples had a significantly higher caloric value by 14.7% ($p \leq 0.05$) in comparison to another breed.

It was found that the Thermon breed had a slightly higher by 8.2% dry matter content in comparison to Belgian Hare minced meat samples. Such parameters as ash content, pH, mois-

Table 1. Chemical composition and nutritional value of minced cuts of meat from rabbits related to Belgian Hare breed, M ± m

Parameters	I	II	III
Moisture, %	71.41 ± 0.66	70.82 ± 0.59	70.83 ± 0.41
Dry matter, %	28.59 ± 0.66	29.18 ± 0.59	29.17 ± 0.41
Protein, %	18.18 ± 0.32	18.02 ± 0.29	18.82 ± 0.22
Fat, %	9.19 ± 0.64	9.29 ± 0.78	9.14 ± 0.66
Ash, %	1.22 ± 0.40	1.87 ± 0.24	1.21 ± 0.49
Ratio protein / fat	1.97	1.93	2.05
Moisture holding capacity, %	56.97 ± 2.25	53.72 ± 0.72	57.36 ± 1.46
pH	5.70 ± 0.03	5.75 ± 0.01	5.73 ± 0.01
Calories, kcals / 100 g	161.77 ± 69.82	162.07 ± 71.69	164.04 ± 58.93

ture in minced meat samples didn't differ significantly or didn't have any tendency for a change.

According to Table 3, the fat content in the II group was higher by 17.7% ($p \leq 0.01$) to the I group and by 12.6% ($p \leq 0.05$) to the II group. The ash content in the III group was significantly ($p \leq 0.05$) lower by 18.6% for the I group and 14.6% for the II group.

There was a slight tendency of the II group to have the highest caloric value (within 5%) comparing to the I and III groups. The content of moisture and dry matter content in *M. longissimus dorsi* didn't have a significant difference within groups with mean values of 75.4% and 24.6% respectively. The pH value of the samples didn't differ and was within the normal meat quality range.

(Fernandez-Carmona et al., 2000) stated that adding fat to the diet leads to its accumulation in meat and carcass, when animals with fat-added diets have higher carcass weight. According to (Fernandez-Carmona et al., 2000) parameters such as protein content and water-holding capacity are significantly lower in groups with higher fat diet. According to Table 4, samples of the II group had significantly higher caloric value in comparison to I and III groups by 9.2 and 10%, respetively ($p \leq 0.05$). The significant difference in caloric value can be explained by a higher content of fat and protein in *M. longissimus dorsi* meat samples. The meat samples of the II group had the least fat content in comparison to the I and III groups by 38.2% and 22.4%. There was a

Table 2. Chemical composition and nutritional value of minced cuts of meat from rabbits related to Thermon, M ± m

Parameters	I	II	III
Moisture, %	68.33 ± 1.72	69.14 ± 1.44	67.85 ± 0.75
Dry matter, %	31.67 ± 1.72	30.86 ± 1.44	32.15 ± 0.75
Protein, %	17.74 ± 0.77	18.20 ± 0.34	17.34 ± 0.49
Fat, %	12.56 ± 1.73	11.35 ± 1.52	13.54 ± 1.04
Ash, %	1.37 ± 0.26	1.31 ± 0.11	1.27 ± 0.22
Ratio protein / fat	1.41	1.60	1.28
Moisture holding capacity, %	54.29 ± 0.93	53.93 ± 1.02	53.33 ± 0.50
pH	5.79 ± 0.03	5.72 ± 0.06	5.75 ± 0.03
Calories, kcals / 100 g	191.34 ± 55.44	182.04 ± 39.52	198.73 ± 86.55

Table 3. Chemical composition and nutritional value of *M. longissimus dorsi* meat from rabbits related to Belgian Hare breed, M ± m

Parameters	I	II	III
Moisture, %	75.73 ± 0.26	75.09 ± 0.16	75.28 ± 0.25
Dry matter, %	24.27 ± 0.26	24.91 ± 0.16	24.72 ± 0.25
Protein, %	21.97 ± 0.13	22.34 ± 0.28	22.49 ± 0.14
Fat, %	1.44 ± 0.10	1.75 ± 0.18	1.53 ± 0.08
Ash, %	0.86 ± 0.22	0.82 ± 0.25	0.70 ± 0.09
Ratio protein / fat	15.2	12.7	14.6
pH	5.44 ± 0.02	5,46 ± 0,01	5.47 ± 0.02
Calories, kcals / 100 g	51.94 ± 26.38	55.30 ± 49.37	52.61 ± 21.80

Table 4. Chemical composition and nutritional value of *M. longissimus dorsi* meat of rabbits related to Thermon breed, M ± m

Parameters	I	II	III
Moisture, %	74.27 ± 0.99	75.30 ± 0.14	73.87 ± 0.81
Dry matter, %	25.73 ± 0.99	24.70 ± 0.14	26.13 ± 0.81
Protein, %	21.46 ± 1.73	21.45 ± 0.19	23.04 ± 0.84
Fat, %	3.09 ± 1.21	1.91 ± 0.31	2.46 ± 0.03
Ash, %	1.18 ± 0.37	1.34 ± 0.36	0.63 ± 0.04
Ratio protein / fat	6.9	11.2	9.3
pH	5.51 ± 0.03	5.46 ± 0.03	5.49 ± 0.02
Calories, kcals / 100 g	118.88 ± 85.09	107.83 ± 36.58	119.70 ± 32.87

tendency to higher protein content (about 6%) in the III group in comparison to I and II groups.

There was no significant difference or any tendency in moisture, dry matter, pH parameters. According to Tables 3 and 4, in terms of the caloric value of the Thermon meat samples exceeded significantly the Belgian Hare by 53.8% ($p \leq 0.001$).

Also, there was significantly higher content of fat (by 37.0%) and ash content (by 23.8%) in the Thermon breed in comparison to Belgian Hare. Though, the concentration of protein content was slightly higher (by 1.3%).

Achieved results indicating relationships between nutritional value of feed and meat quality parameters go along with (Wognin et al., 2018) and (Al-Dobaib et al., 2009). According to Wognin L. (2018) ash content, protein content, lipid content was significantly different in meat of from cross bred (New Zealand x Californian) rabbits with different vegetable diets in comparison to high concentrate industrial diet. Al-Dobaib has found dietary composition affecting most carcass traits, tissue compositions and chemical compositions of the lean in Gabali Saudi rabbits.

Conclusions

The results of the analysis of the nutritional value and chemical composition of meat samples from *M. longissimus dorsi* and minced parts from rabbits of Belgian Hare and Thermon breeds revealed high meat quality. There were significant differences between certain parameters, such as fat, ash, protein content and caloric value within three feed groups and between the Belgian Hare and Thermon rabbit breeds.

It was proved that the meat of rabbits of all experimental groups of the Thermon breed were more tender, it contained less moisture by 3.0–1.6%, more dry matter and more fat content by 4.3–2. 0%, against peers of the respective groups of the Belgian Hare breed. It was found influence of the III feed compound influencing on caloric value of meat by 12.3–21.1%.

There is a certain dependence on feeding dry matter nutrition value and the caloric value of meat, ash, protein and fat content. The increase in the energy content in the dry led to an increase in fat content in minced meat and in the *M. longissimus dorsi* meat of Thermon compared with peers of Belgian Hare breed.

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