



Influence of *Streptomyces levoris* CNMN-Ac-01 on meat productivity and chemical parameters of rabbit meat

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The purpose of the work was to evaluate the influence of biomass of *Streptomyces levoris* CNMN-Ac-01 added to fodder on meat productivity and chemical composition of rabbit meat. The experimental and control groups of animals (each one consisting of 5 rabbits) were formed according to analogous principles of age, sex (only females), body weight, mode of maintenance and feeding. The age of rabbits used for the experiment was 45 days. The control rabbits were fed with granulated fodder produced according to the recipe developed in the laboratory of Nutrition and Forage Technologies. The rabbits in experimental group were fed with the same granulated fodder supplemented with 0.1% biomass of *Streptomyces levoris* CNMN-Ac-01. The results of the chemical analyzes of the used fodder indicated that the elaborated fodder composition provide rabbits with all necessities for their vital activity, where as added biomass of *Streptomyces levoris* CNMN-Ac-01 do not significantly affect its chemical composition. The increase of the protein content by 0.20% and water by 1.15% were observed in meat of experimental rabbits where the content of fat was decreased for 0.71% in comparison to those of the experimental group. The supplementing of streptomycete biomass in granulated fodder had an essential effect on the weight gain of rabbits and improves the bone and meat ratio in the carcass.

Key words: meat, chemical composition, rabbits, fodder, biomass, *Streptomyces levoris* CNMN-Ac-01

According to chemical composition, rabbit meat is superior to beef, sheep and other domestic animals, except for turkey meat, because it contains little fat and relatively more protein [8]. Another advantage of rabbit meat is the high content of minerals, especially potassium, phosphorus, magnesium and in addition high contents of B-complex vitamins, fat-soluble A and E vitamins and very low urate content [4, 7, 9, 10, 13, 17].

Due to the high degree of digestibility, rabbit meat is recommended by nutritionists as a valuable food for growing children, elderly people, patients with cardiovascular and metabolic diseases (diabetes, gout, obesity) and gastrointestinal disorders that have an increased incidence being considered diseases of contemporary civilization [7–10, 16].

Thus, rabbit meat corresponds to the nutritional requirements of consumers, due to the positive influence in maintaining the human health [15, 17].

It is important to mention that the chemical composition of rabbit meat is different even within the same species, varying from one individual to another depending

on the ratio between different tissues, age, sex of the animal, fattening status, etc. [10, 17].

Streptomyces are widespread in nature: in the air, waters, on plant and animal remains, but especially a lot of them are found in soil. In recent years, they are considered not only as producers of antibiotics of different chemical nature, but also of other bioactive substances as enzymes, vitamins, amino acids, lipids, vaccines against human and animal infectious diseases, various drugs of controlling insects and rodents, substances with a phytohormonal activity, which influence the growth and development of plants, stimulate seed germination, and increase crop yields [6, 11, 14]. More than a hundred of medicine drugs produced by soil actinomycetes are used in modern medicine [6].

The object of the study was a strain of *Streptomyces levoris* CNMN-Ac-01, isolated from soils of the R. Moldova and included in the National Collection of Non-Pathogenic Microorganisms of the Institute of Microbiology and Biotechnology of the Academy of Sciences of R. Moldova [2].

The purpose of this studying was to evaluate changes of chemical indices of rabbit meat in response to the supplementation of granulated combined fodder with biomass of *S. levoris* CNMN-Ac-01.

Materials and Methods

The research was carried out on two lots of rabbits of three-breed crossbreeds ♀ (♀ Chinchilla × ♂ New Zealand White) × ♂ California (control lot and experimental lot) of 5 rabbits in each lot. The lots of rabbits were formed according to analogous principles of age, sex, body weight, mode of maintenance and feeding. The age of the rabbits included in the experiment was of 45 days.

The rabbits from the control lot were fed with granulated fodder produced at experimental technological station "Maximovca" according to the recipe elaborated in the Nutrition and Feed Technologies laboratory within Scientific and Practical Institute of Biotechnologies in Zootechny and Veterinary Medicine. The composition of the granulated compound fodder included: alfalfa hay flour, corn, wheat, barley, sunflower cake, soybean meal, alcohol borhot, grape pomace, limestone, vitamin and mineral premix 2% "Rabbit", and kitchen salt.

The rabbits in the experimental lot received the same granulated fodder with the addition of 0.1% biomass of *Streptomyces levoris* CNMN-Ac-01 (4.30×10^8 UFC/g). The duration of the experience was 60 days. After 60 days at the end of the experiment, rabbits of the experimental group were fed without *Streptomyces* during 18 days before slaughter. On the day of the slaughter, the age of the rabbits became 123 days.

At the end of the experiment, control slaughter of rabbits of both groups was carried out according to the corresponding method [1].

To study the chemical composition of the meat, the rabbit carcasses were cut into cuts and deboned. After deboning, minced meat was prepared and an average sample was taken. The chemical composition of the meat was examined at the Eagle lab's apparatus. It was determined the percentage ratio of water, fat, protein and collagen in the carcasses of rabbits in the control and experimental lots.

Statistical processing of the results of the experiment, in order to assess the significance of the differences consisted in grouping the material, calculating the arithmetic mean (M), error (m) and the confidence criterion [12].

Results and Discussions

Initially, the chemical composition of granulated compound feed with and without the supplementing of *S. levoris* CNMN-Ac-01 was studied. It was found that control and experimental granulated feed contain 18.18% and, respectively 18.23% of crude protein. The crude fat content in the dry matter constituted 2.83% in the experimental granulated fodder and 3.12% in the control one. Crude cellulose

in the control granulated fodder constituted 16.30%, and in the experimental granulated fodder 15.87% [5].

As a result of the study of the chemical composition of the control and experimental combined granulated forages, it was found that the biomass of *S. levoris* CNMN-Ac-01 did not significantly influence their chemical composition, and the developed granulated forage recipe provided rabbits with nutrients (crude protein, crude fat, etc.) necessary for their vital activity [5].

Until slaughter, the clinical examination of each rabbit was carried out and their body mass was determined.

As a result of the clinical examination of rabbits of control and experimental lots, were not found deviations from the physiological norm, and their general condition was good, the fur smooth and clean, the mucous membranes pale pink, without elimination or inflammatory processes.

After slaughter, were examined the carcasses and internal organs of the rabbits. The carcasses had a characteristic pink-red color (fig. 1, 2), white-yellow adipose tissue, internal organs without structural changes.

The average body mass at the age of slaughter is economically important, and some authors [1, 16] mention that it must constitute 50–60% of the weight of the adult rabbit. The better the adult rabbit is maintained before the time of slaughter, the higher is the slaughter yield and the better is the quality of the meat. Rabbits in the control lot, at the age of 123 days weighed 2790.80 g, and those in the experimental lot by 4.53% more.

One of the most important characteristics of the productive qualities that determine the effectiveness of rabbit breeding is slaughter indicators. Rabbits at earlier terms reach certain indicators of live weight and slaughter qualities [9, 10]. The meat qualities of rabbits were assessed by the pre-slaughter and slaughter weights, and the slaughter yield was calculated based on the weighing results. Table 1 shows the analysis of indicators of slaughter of rabbits.

Table 1. Results of control slaughter of rabbits (M±m, n=5)

Indicators	Control lot	Experimental lot
Slaughter qualities		
Pre-slaughter live weight, g	2790.80±49.71	2917.20±30.82
Freshly slaughtered carcass weight, g	1358.00±33.06	1478.40±30.84* (td=2,66)
Chilled carcass weight, g (after 24 hrs)	1347.20±32.38	1467.60±30.73* (td=2,70)
Kidney weight with perineal fat, g	90.00±9.78	113.60±10.80
Slaughter weight, g	1437.20	1581.20
Slaughter output/yield, %	51.50	54.20
Morphological composition of carcasses		
Half carcass weight, g	729.33±5.70	740.33±22.30
meat, g	526.00±9.45	571.33±6.77
bones, g	202.00±11.14	166.67±13.87
Meat coefficient	2.60	3.43

Note. * — P≤0.05.



Fig. 1. Rabbit experimental carcasses



Fig. 2. Rabbit control carcasses

The weight of freshly slaughtered carcass in the rabbits of the experimental group is by 120.4 g higher in relation to the control group, the difference is significant ($t_d=2.66$), as well as in the weight of the chilled carcass. The slaughter yield is the ratio of slaughter weight to live weight before slaughter expressed in percentages. It is recommended that this ratio must be increased as much as possible. Its value differs depending on the state of maintenance of the rabbit, breed and age. In the control lot the slaughter yield was 51.50%, and in the experimental one it achieved 54.20% or by 2.7% higher.

As a result of the carried out research, it was found that, in the meat of rabbits from the experimental lot, the water was 75.22%, or lower by 1.15% in comparison to control lot (table 2).

The proteins are found in the muscle tissues that is the most important component of meat. In relation to the meat of other domestic animals, the rabbit meat is characterized by the highest percentage of protein, being of great nutritional value.

In the meat of rabbits, in the experimental lot was 19.19% protein and 1.31% collagen, being respectively by 0.2% and 0.1% more compared to the control lot.

Table 2. Chemical composition of rabbit meat, %

Specify	Control lot			Experimental lot		
	M±m	δ	Cv,%	M±m	δ	Cv,%
Water	74.07±0.34	0.59	0.79	75.22±0.88	1.53	2.04
Fat	5.47±0.41	0.71	12.95	4.76±0.58	1.01	21.25
Protein	18.99±0.08	0.13	0.68	19.19±0.21	0.36	1.86
Collagen	1.30±0.03	0.06	4.28	1.31±0.05	0.09	7.11

According to some authors [1, 10, 16], the excessive fat content reduces the nutritional quality of rabbit meat by decreasing the percentage of protein, so they must be slaughtered until the age of 110–120 days. The rabbit fat is a bioactive substance and a good natural immunomodulator. It is well absorbed by human body and is better in quality than the fats of some other animals. In the meat of rabbits of the control lot, the amount of fat was 0.71% higher compared to the experimental lot.

The ratio of water : protein and water : fat in the meat of the rabbits of the control lot was 3.90:1 and 13.54:1, respectively, and of the experimental one — 3.92:1 and 15.80:1.

Conclusions

The rational use of granulated fodder with the addition of *Streptomyces levoris* CNMN-Ac-01 biomass contributed to obtaining meat with an optimal content of water, protein and fat. At the end of the research period, the body mass of rabbits of the experimental lot exceeded that of rabbits of the control lot by 4.53%, and the ratio of bones and meat in the carcass was 1:3.43 in favor of the experimental lot, which is 0.83 higher in comparison to the control group.

The chemical composition of rabbit meat in experimental group is of the best quality, juicy, with a high protein content (19,19±0.21%) and with a low amount of fat (4.76±0.60%). The increase of the content of protein by 0.20% and water by 1.15% were observed in meat of experimental rabbits where the content of fat was decreased by 0.71% if compared to those of the experimental group.

Prospects for Further Research

In further studies it will be developed a pilot batch of a biological product containing biomass and fluid culture of the *Streptomyces levoris* CNMN-Ac-01 strain. It is planned to conduct pilot production tests of different concentrations of biomass from 0.1% to 1.0% (in the composition of granular feed) and fluid culture from 0.5% to 2.0% (with its addition into the water) on rabbits. For the reliability of the results, the experiment will be conducted on a large number of animals.

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Вплив *Streptomyces levoris* CNMN-Ac-01 на м'ясну продуктивність і хімічні показники м'яса кроликів

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Метою роботи було оцінити вплив біомаси *Streptomyces levoris* CNMN-Ac-01, доданої до корму, на м'ясну продуктивність і хімічний склад м'яса кролів. Експериментальні та контрольні групи тварин (кожна по 5 кроликів) були сформовані за принципами аналогів: за віком, статтю (тільки самки), масою тіла, режимом утримання та годування. Вік кроликів, використаних в експерименті, становив 45 днів. Контрольні кролики отримували гранульований корм, вироблений за рецептурою, розробленою в лабораторії кормів і технології годівлі. Кролики дослідної групи отримували однаковий гранульований корм з додаванням 0,1% біомаси *Streptomyces levoris* CNMN-Ac-01. Результати хімічного аналізу застосованого корму показали, що розроблений кормовий склад забезпечує кроликів всім необхідним для життєдіяльності, тоді як додана біомаса *Streptomyces levoris* CNMN-Ac-01 істотно не впливає на його хімічний склад. У м'ясі дослідних кроликів спостерігали збільшення вмісту білка на 0,20% і води на 1,15%, тоді як вміст жиру знизився на 0,71% порівняно з цим показником у контрольній групі. Додавання біомаси стрептоміцетів до гранульованого корму значно вплинуло на приріст кроликів і поліпшило співвідношення кістки до м'яса : м'ясо в туші.

Ключові слова: м'ясо, хімічний склад, кролики, корм, біомаса, *Streptomyces levoris* CNMN-Ac-01