Bulgarian Journal of Agricultural Science, 27 (No 6) 2021, 1194–1202

Effectiveness of stinging nettle using in the ration of the rabbits

Olga Burmistrova[1], Evgeny Burmistrov[1], Natalya Naumova[2*], Julia Betz[2], Irina Rodionova[1] and Nina Kolobkova [1]

[1]*South Ural State Agrarian University, Chelyabinsk region, Troitsk, Russian Federation*
[2]*South Ural State University, Chelyabinsk, Russian Federation*
[*]*Corresponding author:* n.naumova@inbox.ru
E-mails: olgatzareva@rambler.ru; burmistrow@gmail.com; n.naumova@inbox.ru; bets.jul@yandex.ru; irina_rodionova74@mail.ru; ninusjakol@mail.ru

Abstract

Burmistrova, O., Burmistrov, E., Naumova, N., Betz, J., Rodionova, I. & Kolobkova, N. (2021). Effectiveness of stinging nettle using in the ration of the rabbits. *Bulg. J. Agric. Sci., 27 (6)*, 1194–1202

The use of cheap unconventional herbal fodders in rabbit breeding is of scientific and practical interest. The article presents the results of studying the influence of the supplementary feeding with stinging nettle hay on the balanced ration, gain, development, and meat productivity of rabbits. The replacement of 5% and 25% of coarse fodder with stinging nettle hay resulted in an increase in the content of crude (by 3.5-20.3%), digestible protein (by 4.4-22.8%) and carotene (by 3.3-22.7%) in terms of nutritional value. The introduction of 5% of nettle hey of the coarse fodder nutrition value into the rabbit ration contributed to a larger gain in the live weight of rabbits (aged 130 days – by 62.7%, $P < 0.01$; aged 180 days – by 18.7%, $P < 0.05$) and ensured a high meat productivity. Thus, the following indicators increased due to the muscle tissue gain: preslaughter weight – by 11.6%, $P < 0.01$ and slaughter weight – by 13.4%, $P < 0.01$; the weight of the matured carcass – by 13.4%, $P < 0.01$. When 25% of stinging nettle hay of the coarse fodder nutrition value were introduced into the ration, we observed an increase in the heart muscle (the power of influence is 22.0%, $P < 0.05$).

Keywords: the growth and the development; meat productivity; rabbits; stinging nettle

Introduction

The production of rabbit meat is a promising field of animal breeding. Rabbits are characterized by multiple fetation and high precocity. One rabbit annually gives over 30 times more meat than its own weight (Belov & Uvarov, 2018).

Today, meat is produced in Russia at the expense of farms, the profitability of which directly depends on the type and cost of feeding. Cheapening of products, increased gains, production of rabbit meat with a predetermined chemical composition and properties are possible with the use of cheap unconventional fodders which are widespread (Bessonov & Komlatsky, 2016; Fedotova et al., 2018; Rafiev & Kulchanovsky, 2019). In the Ural region, stinging nettle, which grows almost everywhere, meets all these requirements (Denner & Epryntseva, 2014).

Nettle is a source of protein, vitamins C, K, carotene, iron, calcium, copper, cobalt, magnesium (Pekh, 2019). Nettle leaves contain tannins, formic, gallic, pantothenic and folic acids, urticide glycoside, vegetable gum, protoporphyrin, coproporphyrin, histamine, phytoncides and up to 5% of chlorophyll (Ignatovich, 2017; Stepanova et al., 2017; Uranov & Kruglova, 2019). In folk medicine, nettle is used as a hemostatic agent, a multivitamin, tonic, enhancing and stimulating basis of protein and carbohydrate metabolism (Trineeva et al., 2015; Trineeva & Slivkin, 2017; Tatvidze & Kupatashvili, 2018). Nettle is used for supplementary feeding of cattle, pigs, poultry, rabbits, dogs. As a result, the productivity and live weight of animals increase, and the cost of fodder per 1 kg of the gain decrease (Nikolaychev, 1997; Alieva et al., 2016; Yakovchik, 2017). However, the literature lacks complete and reasonable data on the influence of nettle on the biochemical, physicochemical and technological properties of slaughter animal meat.

The purpose of the research was to study the influence of the supplementary feeding with stinging nettle hay on the balanced ration, gain, development, and meat productivity of rabbits.

Materials and Methods

The objects of research were: fodder base, live animals and slaughter products of Soviet Chinchilla rabbits. This breed is the most widespread and promising in Russia among combined rabbits, have an excellent inherent earliness and a high breeding intensity. The most active increase in the live weight is observed in the first 2-4 months of the animal life, during the intensive gain period (Zhitnikova, 2004).

The studies covered 30 rabbits aged from 3 to 6.5 months. 3 groups of animals were formed: control and two experimental groups, 10 animals each. Rabbits of the control group received a ration of oats, wheat bran, carrots, cabbage, cereal-and-legume hay and natural land grass (in the summer months) (Ryadchikov, 2012). 5% of the coarse fodder nutritional value was replaced with stinging nettle hay for the rabbits of experimental group I, and 25% were replaced for experimental group II.

The rabbits were selected by the principle of pairs of analogues (Viktorov & Menkin, 1991; Zabelina, 2014), were kept in group cages in identical conditions. All the animals were clinically healthy. The feeding rations for all the rabbit groups were balanced by all nutrients according to the current standards (Kalashnikova et al., 2003). To make rations, a comprehensive zootechnical analysis of the used fodder was carried out with the help of the IR-4500 infrared analyzer. The content of basic nutrients in the fodder was determined as follows: nitrogen – by Kjeldahl method, fiber – by Kebenerg and Shtoman method, sugar – by the ebuliostatic method, calcium – by the trilonometric method, phosphorus – by the colorimetric method, ash – by the dry ashing method (Kirilov et al., 2008).

To prepare nettle hay, young nettle was mowed in May-June and dried in the shade to a moisture content of 12.16%,

Table 1. The ration for the rabbits aged 90–120 days

Type of fodder and nutritional value	Norm	Animal groups		
		control	experimental I	experimental II
Carrots, g	–	20	20	20
Cabbage leaf, g	–	20	20	20
Oats, g	–	50	50	50
Grass-and-legume hay, g	–	140	130	95
Nettle hay, g	–	0	10	45
Wheat bran, g	–	40	40	40
Feed chalk, g	–	1	1	1
Natural grass, g	–	350	350	350
The ration contains:				
Feed units, g	170-225	204	203	198
Exchange energy, MJ	1.78-2.36	2.15	2.14	2.08
Dry matter, g	195-235	262	262	263
Crude protein, g	37-49	35.4	36.6	40.8
Digestible protein, g	28-37	25.7	26.7	30.2
Crude fiber, g	23-30	66.8	66.0	63.4
Calcium, g	0.9-1.1	2.13	2.16	2.25
Phosphorus, g	0.6-0.7	1.12	1.13	1.17
Carotene, mg	2.0-2.6	15.0	15.5	17.0
Digestible protein per 1 feed unit, g	100-160	125.6	131.4	152.3
The level of digestible protein from dry matter, %	12	9.8	10.2	11.5
Ca level in dry matter, %	0.8-1.2	0.8	0.8	0.9
The amount of exchange energy (AEE) in 1 kg of dry matter, MJ	9.5-10.0	8.23	8.16	7.93
The level of crude fiber in dry matter, %	12–15	25.5	25.2	24.1
Ca:P ratio	1-1.5:1	1.9:1	1.9:1	1.9:1

because rabbits usually do not eat freshly cut nettles (Balakirev et al., 2015; Kahikalo et al., 2018).

The growth and development of rabbits were assessed by their live weight, average daily and relative gains. Control weighing of the animals was carried out once a week. The rabbits were slaughtered at the age of 6.5 months after fasting for 24 hours. After stunning, the carcasses were bled white by cutting off the heads. The skins were cased, the extremities were removed along the carpal and tarsal joints, and the carcasses were eviscerated and trimmed. The meat was left at a temperature of 15±5 °C for 18 hours for maturation. The meat productivity of the rabbits was evaluated by the preslaughter and slaughter weight, carcass weight and slaughter yield. The rabbit fatness category was established by the muscle development degree, protrusion of dorsal vertebrae, deposition of fat on the shoulders, groin and kidneys. The deboning results were used to determine the weight and ratio of the muscle, bone, fat and connective tissue in the rabbit carcasses using conventional methods, calculated the meat coefficient, measured the weight of slaughterhouse by-products, and calculated their yield (Aleksandrov & Kosova 2011; Gorbunov, 2012).

Statistical processing of the research results was carried out according to a regulated method (Vasilieva, 2007) using the Microsoft Excel XP and Statistica 8.0 software suites. The dependencies in the experimental data were searched using the variance analysis (Yudenkov, 2013).

Results and Discussion

Rationing and feeding of rabbits

All the experimental animals were fed analogously during the experiment, using the same fodder (with the exception of nettle hay) based on their age and live weight. The rations were formulated taking into account the age of the animals: for the age of 90-120 days and for the rabbits older than 120 days. Tables 1 and 2 summarize the rations and their analysis.

The rations of all the experimental rabbits aged 90-120 days were balanced by the main nutrients, except for the high fiber content (1.6-1.7 times above the norm). The rations of the experimental groups, as opposed to the control group, contained slightly less feed units (by 1-6 g feed units) and, accordingly, less AEE (by 0.07-0.3 MJ), but significantly more crude (by 1.2-5.4 g) and digestible protein (by 5.8-26.7

Table 2. The ration for the rabbits aged over 120 days

Type of fodder and nutrition	Norm	Animal groups		
		control	experimental I	experimental II
Carrots, g	–	100	100	100
Cabbage leaf, g	–	250	250	250
Oats, g	–	50	50	50
Grass-and-legume hay, g	–	150	140	100
Nettle hay, g	–	0	10	55
Wheat bran, g	–	50	50	50
Feed chalk, g	–	1	1	1
The ration contains:				
Feed units, g	200-220	197	196	192
Exchange energy, MJ	2.09-2.3	2.08	2.07	2.02
Dry matter, g	200-220	238	239	244
Crude protein, g	34-37	31.6	32.8	38.6
Digestible protein, g	26-29	23.4	24.4	29.2
Crude fiber, g	35-39	53.3	52.5	50.4
Calcium, g	1.3	1.75	1.78	1.92
Phosphorus, g	0.8	1.75	1.76	1.82
Carotene, mg	2.4-2.6	11.5	12.0	14.1
Digestible protein per 1 feed unit, g	100-160	118.8	124.7	152.6
The level of digestible protein from dry matter, %	12%	9.8	10.2	12.0
Ca level in dry matter, %	0.8-1.2	0.7	0.7	0.8
The amount of exchange energy (AEE) in 1 kg of dry matter, MJ	9.5-10.0	8.73	8.65	8.28
The level of crude fiber in dry matter, %	12–15	22.3	22.0	20.7
Ca:P ratio	1-1.5:1	1.0:1	1.0:1	1.1:1

g per 1 g feed units) and carotene (by 0.5-2.0 mg).

The rations for the older rabbits, similar to the rations for the young rabbits, were characterized by increased fiber content – by 1.4-1.5 times. The rations of the experimental groups contained more crude (by 1.2-7 g) and digestible protein (by 5.9-33.8 g per 1 g of feed unit), carotene (by 0.5-2.6 mg) and slightly less AEE (by 0.08-0.45 MJ) than in the control group. The increased content of crude and digestible protein, carotene and vitamin E in the rations of experimental groups I and II throughout the entire period of the experiment was preconditioned by the addition of the stinging nettle hay, which coincides with the data of other researchers (Aitken & Wilson 1966; Kalugin, 1985; Sarnatsky, 1990; Khokhrin, 2002). However, due to the lower energy value of the stinging nettle hay than the grass-and-legume hay, there was a decrease in the AEE in the rations of the experimental groups as compared to the control group.

The ration structure for the rabbits aged 90-120 days included coarse fodder of 29-31%, succulent fodder – 2-3%, green fodder – 27-28%, concentrates – 39-41%. The ration for the rabbits aged over 120 days included coarse fodder of 32-34%, succulent fodder – 21-22%, concentrates – 45-46%, there was no green fodder.

Studying of the growth and development of the rabbits

It is known that rabbits from birth to the age of 4 months, i.e., until puberty, are at the progressive growth stage. This stage is characterized by a high absolute gain, high growth constant, high potential to regeneration synthesis of proteins and protoplasm in general (from 177.2 to 130.0 mg of nitrogen per 1 g of protein nitrogen per day) at a stably low recovery synthesis (Skopichev & Shumilov, 2004). The change in the indicators of the rabbits' live weight is presented in Figure 1.

An analysis of the data has shown that during the first three weeks of the experiment, the animals of all the groups were developing approximately the same, although already

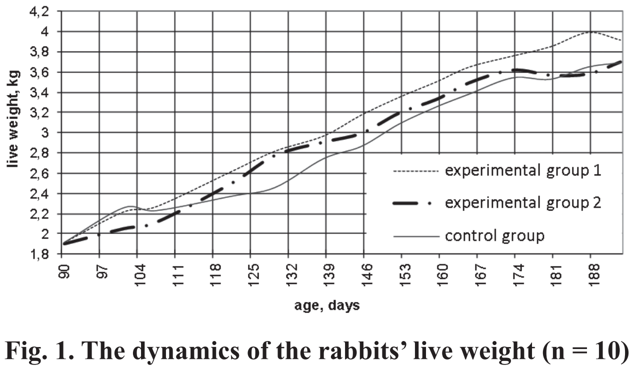

Fig. 1. The dynamics of the rabbits' live weight (n = 10)

at this stage the rabbits of experimental group I were somewhat ahead of the rest. During the fourth and fifth weeks of the experiment (animal age 107-121 days), the live weight of the experimental rabbits increased, and at the age of 130 days, the weight of the rabbits receiving 5% of the stinging nettle hay was 0.360 kg more (by 14.65%, $P < 0.05$) than in the control group, and the weight of the animals receiving 25% was 0.318 kg (12.9%, $P < 0.05$). The differences between the indicators of both experimental groups are unreliable.

During the 5th month of life (145-193 days), the rabbits were growing almost identically, while the advantage of experimental group I remained. Starting from the age of six months old (180-187 days), the rabbits of experimental group I were significantly ahead of the rest; their weight exceeded the weight of the animals of the control group by 0.342 kg (9.34%, $P < 0.05$), of experimental group II – by 0.411 kg and 11.48% respectively ($P < 0.01$). A comparison of the dynamics of the live weight and the dynamics of the daily average gain during the experiment presented in Figure 2 confirmed the above picture.

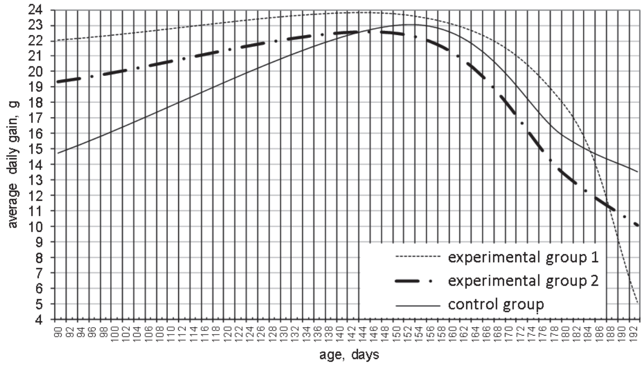

Fig. 2. The dynamics of the rabbits' daily average gain (n = 10)

It has been established that at the age of 120 days, the average daily gain in the animals of experimental group I significantly exceeded the control group (by 7.3 g or 49.5%, $P < 0.05$) and experimental group II (by 2.7 g or 13. 9%). During the first 2 months of the experiment (rabbit age 120-150 days), the rabbits of the experimental groups gained approximately the same weight, and in the control group the gains increased sharply. At the same time, the average daily gain in experimental group I exceeded the gain in experimental group II and in the control group. At the age of 150 days and until the end of the experimental period, a decrease in the gain rate was observed in all the experimental animals, which had approximately the same intensively up to the age of 6 months (180 days). Then, the average daily gains in the rabbits of experimental group I fell sharply, and at the age of 183 days, for the first time over the entire study period, they became less than in experimental II and control groups. This is explained by a change in the grass-and-legume hay in the ration of the experimental animals. The rabbits of the control group and experimental group II took a partial change in the ration almost painlessly, and the most productive animals of experimental group I experienced significant stress. We consider such results to be logical.

Based on the fact that the best results of the live weight increase were obtained in the rabbits aged 130 days and 180 days, we evaluated absolute, average daily and relative gains over these periods as compared to the full experimental period (Table 3).

Considering the indicators of the rabbits' live weight at the beginning and end of the experiment (up to the age of 194 days), it has been established that the best indicators were shown by the rabbits of experimental group I. Thus, the absolute, average daily and relative gains in this group were higher than in the control group by 0.23 kg (12.65%), 1.32 g (7.69%) and 8.1%, and as compared to experimental group II, these indicators were 0.20 kg (11.28%), 0.97 g (5.56%) and 0.34%, respectively.

Breeding the rabbits to the age of up to 6 months (180 days) was characterized by a slight increase in the average daily gains. At the same time, the animals of experimental group I grew faster than in experimental group II (by 2.75 g or 14.86%) and the control group (by 3.36 g or 18.73%, P < 0.05). The absolute increase in the live weight in the rabbits of experimental group I was also significantly larger than in the control animals (by 0.30 kg or 18.77%, P < 0.05).

The highest growth rate was observed when the animals were fatted to the age of 130 days. During this period, the superiority of the rabbits of the experimental groups over the control animals was clearly traced. In experimental group II, the absolute gain in the live weight was 0.33 kg more (61.18%, P < 0.05), and the daily average gain was 8.52 g (61.18%, P < 0.05). In the animals of experimental group I, the absolute gain was larger by 0.34 kg (62.72%, P < 0.01), the average daily gain was 8.73 g (62.72%, P < 0.01), and the relative gain was 16.6% (P < 0.05).

A variance analysis was conducted to assess the influence of the supplementary feeding with the nettle hey on the live weight indicators (Table 4).

Table 4. The indicator of the influence of the supplementary feeding with the nettle hey on the indicators of the rabbits' live weight, % (n = 10)

Name of indicator	Animal age, days		
	90-194	90-180	90-130
Live weight	17.44	28.3*	32.2*
Average daily gain	12.2	17.0	41.5**

* P < 0.05; ** P < 0.01

According to the variance analysis results, we have recorded the maximum influence of the supplementary feeding with the stinging nettle hey hay on the live weight indicators during fattening up to the age of 130 days. At this age, the influence of nettle on the rabbits' live weight was 4% more than at the age of 90-180 days, and 14.8% more than when the rabbits reached the age of 194 days. In case of longer fattening, the influence of the supplementary feeding with the stinging nettle hey decreased by 2.4 times (up to 180 days) and 3.4 times (up to 194 days).

Table 3. Indicators of the live weight of the rabbits in different age periods ($\bar{X} \pm S\bar{x}$, n = 10)

Animal groups	Live weight, kg		Absolute live weight gain, kg	Average daily live weight gain, g	Relative live weight gain, %
	beginning of the experiment	end of the experiment			
age 90-194 days					
control	1.914 ± 0.106	3.692 ± 0.095	1.778 ± 0.112	17.13 ± 1.08	95.43 ± 10.67
experiment I	1.914 ± 0.091	3.917 ±0.083	2.003 ± 0.052	18.45 ±0.50	103.52 ±5.28
experiment II	1.900 ± 0.143	3.700 ± 0.093	1.800 ± 0.111	17.48 ± 1.07	103.18 ± 17.79
age 90-180 days					
control	1.914 ± 0.106	3.529 ± 0.086	1.614 ± 0.131	17.94 ± 1.46	87.81 ± 11.70
experiment I	1.914 ± 0,091	3.850 ± 0.092*	1.917 ± 0.048*	21.30 ± 0.53*	99.95 ± 4.77
experiment II	1.900 ± 0.143	3.586 ± 0.088	1.669 ± 0.122	18.54 ± 1.35	96.46 ± 18.20
age 90-130 days					
control	1.914 ± 0.106	2.457 ± 0.079	0.543 ± 0.069	13.92 ± 1.76	29.43 ± 4.53
experiment I	1.914 ± 0.091	2.817 ± 0.095*	0.883± 0.048**	22.65 ± 1.22**	46.03 ± 3.01*
experiment II	1.900 ± 0.143	2.775 ± 0.088*	0.875 ± 0.092*	22.44 ± 2.36*	51.44 ± 11.44

* P < 0.05; ** P < 0.01

Thus, the introduction of the stinging nettle hay into the ration significantly increased the rabbits' live weight gain. At the same time, the best results were observed when feeding the nettle hay in the amount of 5% of the coarse fodder nutritional value. It is more advisable to breed animals to the age of 130 days (4-4.5 months) after the most intensive growth and development period. By this age, rabbits already exceed the minimum slaughter weight of 2.4 kg. Notably, the obtained results coincide with the data of many authors who claim that it is economically more profitable to breed rabbits to this age (Vagin & Tsvetkova, 1991; Erin et al., 1994; Zhitnikova, 2004).

Studying of the rabbits' meat productivity. Morphological and commodity assessment of carcasses

According to the requirements, the carcass weight should be at least 1.1 kg. The slaughter yield of rabbits varies depending on the age, live weight and fatness of animals from 47% (in young) to 60% (in adults) (Alexandrov & Kosova, 2011; Gorbunov, 2012). These authors report that the haslet yield in rabbit carcasses is about 4%. Notably, there is a positive correlation between the live weight and the morphological composition of rabbits (Lewczuk et al., 2000).

It has been determined that the fatness of the animals of all the groups corresponded to the first category of fatness: the muscles were well developed, the hips were well-shaped and rounded, spinous processes of the dorsal vertebrae did not protrude, the fat on the shoulders and groin had the shape of thickened strips, kidneys were covered with fat by more than a half.

We measured such indicators as the preslaughter weight and slaughter weight and calculated the slaughter yield to assess the meat productivity (Table 5).

It has been determined that the preslaughter weight of the rabbit carcasses in experimental group I significantly exceeded the value of the control group (by 380 g or 11.60%, P < 0.01), while in experimental group II the difference was insignificant (by 105 g or 3.21%). A similar regularity has been observed when comparing slaughter weights: in experimental group I, it was more than in the control group by 205.61 g (13.37%, P < 0.01), and in experimental group II – only by 48.94 g (3.18%). In this case, the preslaughter and slaughter weights of the carcasses of experimental group I exceed those of experimental group II – by 275 g (8.14%, P < 0.01) and 156.67 g (9.88%, P < 0.01), respectively. The carcasses of experimental group I had the highest slaughter yield, while the carcasses of the control group had the lowest slaughter yield.

The above differences confirmed the variance analysis results (Table 6).

Table 6. The influence of the supplementary feeding with stinging nettle hay on the meat productivity of rabbits (n = 10)

Name of indicator	Power of influence indicator, %
Preslaughter weight, g	30.9**
Slaughter weight, g	28.0*
Slaughter yield, %	3.6

* P < 0.05; ** P < 0.01

It has been determined that the introduction of the stinging nettle hay into the ration had approximately the same influence (about 30%) on the differences between the preslaughter and slaughter weight of the rabbits in the control and experimental groups.

Thus, the introduction of 5% of the nettle hay of the coarse fodder nutritional value into the ration of the rabbits provided the best slaughter qualities.

When studying the morphological composition of the rabbit carcasses, the matured meat was deboned, flesh, bones, fat and connective tissue were separated. The deboning results are shown in Table 7.

Analyzing the obtained data, it is clear that the carcass weight after maturation in experimental group I was significantly larger than in the control group (by 192.03 g or 13.45%, P < 0.05) and experimental group II (by 150.15 g; 10.21%, P < 0.05). Accordingly, the carcasses of experimental group I have more muscle tissue than in the control group by 118.60 g (11.62%, P < 0.05), and in experimental group II – by 116.31 g (11.37%, P < 0.05). The content of bone, fat and connective tissue in all the rabbit meat samples was approximately the same. The differences between the mass fractions of muscle, bone, fat and connective tissues were

Table 5. Meat productivity of the rabbits ($\overline{X} \pm S\overline{x}$, n = 10)

Name of indicator	Animal groups		
	control	experiment I	experiment II
Preslaughter weight, g	3275.00 ± 115.77	3655.00 ± 39.76*	3380.00 ± 64.64
Slaughter weight, g	1537.52 ± 60.50	1743.13 ± 33.08*	1586.46 ± 42.72
Slaughter yield, %	46.89 ± 0.36	47.68 ± 0.63	46.92 ± 0.80

* P < 0.01

Table 7. Morphological composition of the rabbit carcasses ($\bar{X} \pm S\bar{x}$, n = 10)

Name of indicator	Animal groups		
	control	experiment I	experiment II
Carcass weight after maturation, g	1427.75 ± 69.81	1619.78 ± 43.05*	1469.63 ± 39.57
Muscle tissue weight, g	1020.74 ± 45.52	1139.34 ± 32.18	1023.03 ± 40.34
Mass fraction of muscle tissue, %	71.52 ± 0.86	70.39 ± 1.17	69.52 ± 1.64
Bone tissue weight, g	284.00 ± 9.33	299.50 ± 4.25	290.00 ± 8.98
Mass fraction of bone tissue, %	20.06 ± 0.46	18.61 ± 0.56	19.84 ± 0.77
Fat and connective tissue weight, g	122.97 ± 19.54	180.93 ± 23.76	156.61 ± 19.17
Mass fraction of fat and connective tissue, %	8.42 ± 1.10	11.01 ± 1.27	10.64 ± 1.19

*P < 0.05

insignificant. In our opinion, an increase in the content of fat and connective tissue in experimental group I of the rabbits is connected with an improvement in metabolic processes due to an increase of proteins, carotene, vitamins of group B, D, and other biologically active substances in the diet. At the same time, there was an increase in the total live weight in the experimental groups as compared to the control. Similar results were obtained in the studies of Yakovinchik & Yakovinchik (2017), Zubova et al. (2019). High concentrations of stinging nettle hay in the diet may be associated with a negative pharmacological effect of vitamin K, which increases blood clotting.

The content of edible parts of the carcass characterizes the coefficient of meatiness studied in Table 8.

Table 8. Meatiness of the rabbit carcasses, % ($\bar{X} \pm S\bar{x}$, n = 10)

Animal groups		
Control	experiment I	experiment II
83.56 ± 0.74	85.76 ± 1.04	84.70 ± 1.00

It has been established that the rabbit carcasses of experimental group I has the highest meatiness, while the lowest meatiness was in the control group. However, the differences between the groups were insignificant by this indicator. It is known that the average meatiness index is 85% (Aleksandrov & Kosova, 2011; Gorbunov, 2012), therefore, the test results of the samples of experimental group I are the closest to these data.

Table 9. The influence of the supplementary feeding on the morphological composition and meatiness of rabbit carcasses (n=10)

Name of indicator	Power of influence indicator, %
Carcass weight after maturation	21.4*
Muscle tissue weight	16.4
Bone tissue weight	6.7
Fat and connective tissue weight	9.7
Meatiness	9.2

* P < 0.05

During the variance analysis, we have established the influence of the supplementary feeding with nettle on the morphological composition and meatiness of rabbit meat (Table 9).

The introduction of the stinging nettle hay into the rabbit ration significantly influenced the gain in the carcass in general (21.4%, P < 0.05) and, to a lesser extent, the increase in the muscle tissue (5% less). According to the results of deboning and the calculation of meatiness, we can conclude that the introduction of the nettle hay into the rabbit ration in the amount of 5% of the nutritional value of coarse fodder resulted in an intensive gain in the muscle tissue.

During the slaughter and evisceration of rabbits, we measured the weight of slaughterhouse by-products (haslet) and calculated their yield. The research results are presented in Table 10.

It follows from the above data that the haslet weight and yield in general, as well as the weight of individual slaughterhouse by-products did not differ significantly, except for the heart weight: in the animals of experimental group II, this indicator is more than in the rabbits of the control group by 1.87 g (19.06%, P < 0.05), and more than experimental group I by 1.66 g (16.57%, P < 0.05). The differences between the heart weight of the animals of experimental group I and the control group were unreliable. The obtained results were confirmed by the variance analysis (Table 11).

The supplementary feeding with the stinging nettle hay had the maximum influence on the heart weight (P < 0.05), the dependence of the weight of other internal organs on the addition of nettle to the ration is unreliable. The obtained data indicated an increase in the heart muscle with an increase in stinging nettle to 25% of the nutritional value of coarse fodder in the ration. Alongside with that, it should be noted that the yield of haslet from all the meat samples exceeded the average value indicated by Alexandrov & Kosov (2011), Gorbunov (2012) by 1.9-2 times.

Table 10. Weight and yield of the slaughterhouse by-products ($\bar{X} \pm S\bar{x}$, n = 10)

Name of indicator	Animal groups		
	control	experiment I	experiment II
Heart weight, g	9.81 ± 0.63	10.02 ± 0.56	11.68 ± 0.34*
Liver weight, g	95.59 ± 3.98	97.49 ± 5.17	88.14 ± 2.14
Lung weight, g	14.70 ± 0.26	15.76 ± 0.72	14.26 ± 0.57
Total haslet weight, g	120.10 ± 3.67	123.27 ± 5.41	114.08 ± 2.30
Haslet yield, %	8.20 ± 0.24	7.45 ± 0.36	7.60 ± 0.21

* - P < 0.05

Table 11. The influence of the supplementary feeding with the stinging nettle hay on the weight and yield of slaughterhouse by-products (n = 10)

Name of indicator	Power of influence indicator, %
Heart weight	22.0*
Liver weight	10.3
Kung weight	12.6
Total haslet weight	9.2
Haslet yield	12.9

* P < 0.05

Conclusions

The replacement of 5% and 25% of coarse fodder with stinging nettle hay resulted in an increase in the content of crude (by 3.5-20.3%), digestible protein (by 4.4-22.8%) and carotene (by 3.3-22.7%) in terms of nutritional value. The introduction of 5% of nettle hey of the coarse fodder nutrition value into the rabbit ration contributed to a larger gain in the live weight of rabbits (aged 130 days – by 62.7%, P < 0.01; aged 180 days – by 18.7%, P < 0.05) and ensured a high meat productivity. Thus, the following indicators increased due to the muscle tissue gain: preslaughter weight – by 11.6%, P < 0.01 and slaughter weight – by 13.4%, P < 0.01; the weight of the matured carcass – by 13.4%, P < 0.01. When 25% of stinging nettle hay of the coarse fodder nutrition value were introduced into the ration, we observed an increase in the heart muscle (the power of influence is 22.0%, P < 0.05).

Acknowledgements

The research was carried out with the support of the Government of the Russian Federation (Decree № 211 of 16.03.2013), agreement № 02.A03.21.0011.

References

Aitken, F. & Wilson, U. (1966). Feeding rabbits. Moscow, Kolos, 126 (Ru).

Alexandrov, S. N. & Kosova, T. I. (2011). Rabbits: Breeding, Rearing, Feeding. Moscow: AST, 180 (Ru).

Aliyeva, S. M., Akhmedkhanova, R. R. & Astarkhanova, T. S. (2016). The realization of the bioresource potential of broiler chickens using the stinging nettle and seaweed flour. *Problems of the Development of Regional Agro-Industrial Complex, 1-2 (25),* 70-73 (Ru).

Balakirev, N. A., Nigmatulin, R. M. & Sushentsova, M. A. (2015). Fodders and feeding rabbits. Moscow, Kazan: Nauchnaya Biblioteka Publishing House, 268 (Ru).

Belov, A .A. & Uvarov, R. A. (2018). Small-scale production of rabbit meat. *Farmer. Volga region, 6 (70),* 92-95 (Ru).

Bessonov, A. M. & Komlatsky, G. V. (2016). Industrial production of rabbit meat in the national animal breeding cluster. *Animal Breeding of the South of Russia, 5 (15),* 12-15 (Ru).

Denner, A. & Epryntseva, E. S. (2014). Searching for new sources of vitamins and antioxidants in the Southern Urals. *International Research Journal, 1-4 (20),* 51-53 (Ru).

Erin, A. T., Plotnikov, V. G. & Ryminskaya, E. I. (1994). Household rabbit breeding and nutria breeding. Minsk, Urozhai, 384 (Ru).

Fedotova, G. V., Skachkov, D. A., Slozhenkina, M. I. & Mosolova, N. I. (2018). Prospects for the development of rabbit breeding in Russia. *Agricultural and Food Innovations, 3 (3),* 42-47 (Ru).

Gorbunov, V. V. (2012). Rabbits. Breeding, management, care. Moscow, AST, 192 (Ru).

Ignatovich, L. S. (2017). Biologically actively supplementary feedings based on herbal flour. *Poultry Farming, 6,* 22-25 (Ru).

Kakhikalo, V. G., Nazarchenko, O. V. & Balandin, A. A. (2018). A practical guide to fur farming and rabbit breeding. St. Petersburg, Lan Publishing House, 328 (Ru).

Kalashnikova, A. P., Fisinina, V. I., Scheglova, V. V. & Kleimenova, N. I. (2003). Norms and rations of feeding farm animals. Reference manual. 3rd revised and enlarged edition. Moscow, Russian Agricultural Academy, 456 (Ru).

Kalugin, Yu. A. (1985). Feeding rabbits. Moscow, Agropromizdat, 112 (Ru).

Khokhrin, S. N. (2002). Fodders and feeding of animals. St. Petersburg, Lan Publishing House, 512 (Ru).

Kirilov, M. P., Makhaev, E. A., Pervov, N. G., Puzanova, V. V. & Anikin, A. S. (2008). A method for calculating the exchange energy in fodders based on the content of raw nutrients. Dubrovitsy: All Russia Research Institute for Animal Husbandry of the Russian Agricultural Academy, 30 (Ru).

Lewczuk, A., Janiszewska, M., Saadi, M. A. A. & Michalik, D. (2000). The utility of certain intravital and post-slaughter traits for the evaluation of carcass tissue composition in Californian rabbits. *Natural Sciences. Olsztyn, 7*, 129-139 (Cze).

Nikolaychev, V. A. (1997). Harvest nettles. *Sheep, Goats, Wool, 5-6,* 28 (Ru).

Pekh, A. A. (2019). The content of chemical elements in stinging nettle (*Urtica dioica* L.) growing in the Republic of North Ossetia-Alania. *Scientific Conference Bulletin, 2-3 (42),* 82-84 (Ru).

Rafiev, A. A. & Kulchanovsky, A. O. (2019). The status and ways to develop small business in the field of rabbit production in the Russian Federation. *Modern Research Bulletin, 1-2 (28),* 79-82 (Ru).

Ryadchikov, V. G. (2012). The basics of nutrition and feeding of farm animals. Krasnodar: Kuban State Agrarian University, 328 (Ru).

Sarnatsky, P. L. (1990). Unconventional crops in fodder production. *Achievements of Science and Technology of the Agro-Industrial Complex, 9,* 22-24 (Ru).

Skopichev, V. G. & Shumilov, B. V. (2004). Morphology and physiology of animals. St. Petersburg, Lan Publishing House, 416 (Ru).

Stepanova, E. F., Kuregyan, A. G., Pechinsky, S. V. & Zhidkova, Yu. Yu. (2017). Recovery of biologically active substances from plant objects in the field technology of pharmaceutical products as exemplified by stinging nettle (*Urtica dioica* L.). *Bulletin of the Russian Military Medical Academy, 3 (59),* 134-139 (Ru).

Tatvidze, M. L. & Kupatashvili, N. N. (2018). A study of some biologically active substances of dry leaves of stinging nettle. *Theoretical & Applied Science, 6 (62),* 157-161 (Kz).

Trineeva, O. V. & Slivkin, A. I. (2017). The determination of total polysaccharides and simple sugars in the leaves of stinging nettle. *Bulletin of Voronezh State University. Series: Chemistry. Biology. Pharmacy, 1,* 164-169 (Ru).

Trineeva, O. V., Slivkin, A. I. & Safonova, E. F. (2015). The determination of hydroxycinnamic acids, carotenoids, and chlorophyll in the leaves of stinging nettle (*Urtica dioica* L.). *Chemistry of Plant Raw Materials*, *3,* 105-110 (Ru).

Uranov, I. O. & Kruglova, N. V. (2019). The improvement of the technology of aqueous recovery from stinging nettle with the maximum yield of organic acids. *Science in the Modern World: Development Priorities, 1 (5),* 106-108 (Ru).

Vagin, E. A. & Tsvetkova, R. P. (1991). Rabbits, nutria, poultry in homestead and peasant farming. Moscow: Irius, 190 (Ru).

Vasilieva, L. A. (2007). Statistical methods in biology, medicine and agriculture. Novosibirsk: Novosibirsk State University, 42 (Ru).

Viktorov, P. I. & Menkin, V. K. (1991). A methodology and organization of livestock experiments. Moscow: Agropromizdat, 112 (Ru).

Yakovchik, N., 2017. The use of stinging nettle in the ration of ruminants. *Animal Breeding of Russia, 12,* 55-59 (Ru).

Yakovchik, N. S. & Yakovinchik, S. G. (2017). Nettle as an unconventional feed in animal husbandry. *Our Agriculture: Veterinary Medicine and Animal Husbandry*, *10,* 2-5 (Ru).

Yudenkov, V.A. (2013). The variance analysis. Minsk: Businessetset, 76 (Ru).

Zabelina, M. V. (2014). Research methods in private zootechnics. Saratov: Saratov State Agrarian University, 60 (Ru).

Zhitnikova, Yu. Zh. (2004). Rabbits: Breeds, breeding, management, care. Rostov-on-Don: Fenix, 256 (Ru).

Zubova, T. V., Grachev, S. Yu. & Saparova, E. I. (2019). An assessment of the impact of the pharmaceutical substance based on stinging nettle on the complex of economically useful qualities of black-and-white calves. *Siberian Journal of Life Sciences and Agriculture*, *11 (1),* 79-89 (Ru).

Received: November, 19, 2020; *Accepted:* February, 19, 2021; *Published:* December, 2021