ТВАРИННИЦТВО

DOI: 10.32636/01308521.2022-(72)-2-8
UDC: 636.92:636.084

M. V. HRYNIV[1], teacher
I. V. TRYNIV[1], candidate of agricultural sciences
L. M. DARMOHRAI[2], doctor of agricultural sciences
[1]Rohatyn State Agricultural College
Shashkevycha street, 61, Rohatyn city, Ivano-Frankivsk region, 77001, e-mail: gryniv_misha@ukr.net
[2]Institute of Agriculture of Carpathian Region NAAS
Hrushevskoho street, 5, v. Obroshyne, Lviv district, Lviv region, 81115, e-mail: murolub15@gmail. com

DIGESTIBILITY OF NUTRIENTS IN THE BODY AND GROWTH INTENSITY OF YOUNG RABBITS USING TRITICALE GRAIN IN FEED RATIONS

The article is devoted to the study of the effect of feeding different amounts of triticale grain in the diet on digestibility of nutrients, body weight, average daily gain, carcass weight and slaughter yield of rabbits from 40 to 90 days of age. It was established that the intake of nitrogen exceeded its excretion with faeces in the animals of the experimental groups, whose rations included triticale grain. It was experimentally proven that the rabbits of the second research group, which were fed compound feed with 12.5% of the grain component replaced by triticale grain, better digested feed nitrogen by 1.39 g or 5.15% ($P<0.05$), compared to the control group. The body weight of animals of all groups during the preparation period was almost the same, but already after 10 days of using different amounts of triticale grain in the diet of rabbits, it was 8% higher in rabbits of the II and III groups. Feeding different amounts of triticale grain in the composition of granulated feed positively affected the weight growth of the rabbits of the experimental groups. It was established that both on the 50th and 90th day, the growth intensity was the highest in rabbits of the II experimental group, in which 12.5% of triticale grain in the composition of the granulated compound feed were replaced, compared to the control. In the animals of the II and III research groups, which consumed granulated compound feed with a content of 12.5% and 35% of triticale grain at the fourth and fifth stages of determination (80th and 90th day of the study), absolute growth increased by 1.3 and 1.2% compared to control group. This indicates an increase in the intensity of their growth. The final stage of the study showed that feeding granulated compound feed containing triticale grain did not have a negative effect on massometric indicators of internal organs. Slaughter yield in II, III and IV experimental groups was 50.2%, 49.5 and 48.3% against 47.6% in the control group. The superiority of the experimental rabbits over the control ones in pulp mass was noted –21.4%, 15.4% and 5.4% by groups respectively. Thus, the obtained results indicate that the introduction of various amounts of triticale grain into the diet as part of granulated

compound feed significantly affects the degree of digestion and assimilation of nutrients in the body of young rabbits, growth intensity, carcass weight and slaughter yield. This means that triticale grain can be partially introduced into the diets of rabbits to increase the intensity of their growth.

Keywords: rabbits, triticale grain, nutrient digestibility, growth intensity, internal organs.

Гринів М. В.[1], Тринів І. В.[1], Дармограй Л. М.[2]

[1]Рогатинський аграрний фаховий коледж

[2]Інститут сільського господарства Карпатського регіону НААН

Перетравність поживних речовин в організмі та інтенсивність росту молодняку кролів за використання зерна тритикале у раціонах

Статтю присвячено дослідженню впливу згодовування різної кількості зерна тритикале сорту Поліське 7 у складі раціону на перетравність поживних речовин, масу тіла, середньодобовий приріст, масу тушки та забійний вихід кролів із 40 до 90-добового віку. Встановлено, що надходження Нітрогену перевищувало його виведення з калом у тварин дослідних груп, до складу раціонів яких входило зерно тритикале. Експериментально доведено, що кролі другої дослідної групи, яким згодовували комбікорм із заміною у ньому 12,5 % зернового компонента зерном тритикале, краще перетравлювали Нітроген корму на 1,39 г, або 5,15 % ($P<0,05$), порівняно з контрольною групою. Маса тіла тварин усіх груп у підготовчий період була майже однаковою, проте вже через 10 діб застосування у раціоні кролів різної кількості зерна тритикале вона була вищою на 8 % у II і III групі. Згодовування у складі гранульованого комбікорму різної кількості зерна тритикале проявило позитивний вплив на ваговий ріст кролів дослідних груп. Встановлено, що як на 50-ту, так і 90-ту добу інтенсивність росту була найвищою у кролів II дослідної групи, яким замінювали 12,5 % зерна тритикале у складі гранульованого комбікорму, порівняно з контролем. У тварин II і III дослідних груп, які споживали гранульований комбікорм з вмістом 12,5 та 35 % зерна тритикале, на четвертому і п'ятому етапі визначення (80 і 90 доба дослідження) збільшився абсолютний приріст на 1,3 та 1,2 % порівняно з контрольною групою. Це свідчить про підвищення інтенсивності їхнього росту. Завершальний етап дослідження показав, що згодовування гранульованого комбікорму із вмістом зерна тритикале не мало негативного впливу на масометричні показники внутрішніх органів. Забійний вихід у II, III і IV дослідних групах становив 50,2 %, 49,5 і 48,3 % проти 47,6 % у групі контрольних ровесників. Відзначено перевагу дослідних кролів щодо контрольних за масою м'якоті – на 21,4 %, 15,4 і 5,4 % відповідно в групах.

Таким чином, отримані результати свідчать, що введення до раціону у складі гранульованого комбікорму різних кількостей зерна тритикале суттєво впливає на ступінь перетравлення і засвоєння поживних речовин в організмі молодняку кролів, інтенсивність росту, масу тушки та забійний вихід. Це означає, що в раціони кролів можна частково вводити зерно тритикале для збільшення інтенсивності їх росту.

Ключові слова: кролі, зерно тритикале, перетравність поживних речовин, інтенсивність росту, внутрішні органи.

Introduction. Rabbit breeding is one of the branches of agriculture that provides the population with dietary meat and valuable down [5, 11, 18]. Rabbits became widespread due to their small size, fast growth, high fecundity, short interval between generations and the ability to consume agricultural by-products as feed [10, 17, 23]. Only in the last 5 years, the industrial population of rabbits has increased by more than 40% [16, 28]. Keeping young rabbits and intensive production of rabbit meat is a resource-intensive process, therefore, a constant search is being made for ways to improve and reduce the cost of their breeding technologies [19, 21]. Taking into account the growing demand for ecologically safe and organic livestock products, several ways of solving this problem have recently been outlined [20]. Important in this regard are measures and techniques that improve the feed conversion ratio, in particular, the use of pro- and prebiotics in fattening rations [12, 25], their enrichment with vitamin and mineral preparations [3, 4, 22], etc. Also for this purpose, the authors [7, 26] propose to optimize the rabbit-keeping system, which allows to reduce the use of antibiotics and improves the quality of rabbit meat products.

As we know, digestibility, i.e., the level of use of feed nutrients in the body, largely depends on the age, the intensity of growth, breed, as well as individual characteristics of animals. Scientific studies have proven that genetic factors have a significant impact on the digestibility of feed nutrients [30]. Some authors claim that the difference in feed digestibility by animals of certain breeds is so insignificant that it does not go beyond their individual deviations [24]. Other researchers found that individual breeds and their hybrids differ in metabolism [27]. It is also known that more intense growth, high precocity, and better fattening qualities of cross-bred animals are associated with an increased level of metabolism in their bodies and that animals of the meat production direction have a higher digestibility of feed nutrients [29].

Optimizing rations during the intensive breeding of rabbits of highly productive hybrids in terms of energy [13, 15], the balance of nutrients, in particular protein [9, 14] is also a relevant way to solve the problem, as it allows the genetic potential of animals to be fully realized.

At the current stage of development of rabbit breeding in Ukraine, the level of feeding and balanced rations in many cases does not meet scientifically based norms [2], which significantly increases the cost of production. One of the means of improving the fodder base is the use of grain from new crops in compound feed, in particular triticale, a cereal crop bred by crossing wheat with rye, which is characterized by high yield, a

high content of protein and essential amino acids, namely lysine [1, 6]. Due to the high content of protein, lysine and tryptophan, triticale grain is well combined with other components in compound feed [2]. The recommended amount of its introduction for young pigs is 40–50%, for broiler chickens – 10–15% of the weight of grain, while the reduction in the price of compound feed is 8–9% for piglets and 4.5–9% for poultry.

Based on the above, as well as the fact that the volume of triticale grain production in our country is growing annually, its use in the diets of various species of animals and poultry is increasing. Research aimed at studying the metabolic and productive effects of the use of this cereal crop is of scientific and practical interest in compound feed for rabbits.

Materials and methods. The research was conducted on the basis of LLC "Pan krol" of the Rohatyn district, Ivano-Frankivsk region, on young rabbits of the Termon breed. According to the principle of analogues, at the age of 40 days, four groups of animals (I – control and II–IV – experimental) were formed, 15 animals each. They were kept in rooms with regulated microclimate and lighting in cages measuring 50x120x30 cm (Table 1). The conditions of keeping corresponded to the accepted veterinary and sanitary standards.

1. Scheme of the experiment

Group	n	Nature of feeding
I control	15	MR (main ration)
II experimental		MR + 12.5 % triticale grain grits
III experimental		MR + 35 % triticale grain grits
IV experimental		MR + 50 % triticale grain grits

Rabbits of the control group were fed ad libitum standard complete-ration granulated compound feed (MR), which included: barley and oat grain, wheat bran, soybean cake, sunflower meal, grass flour, premix. Animals had free access to water. Rabbits of the II, III and IV experimental groups were fed the compound feed of the control group with the replacement of oat and barley grains in its composition (from their mass in the compound feed) with triticale grain of the Poliske 7 variety, at the rate of 12.5%, 35% and 50%, respectively. The duration of the study – 50 days. All animal manipulations were performed in accordance with the European Convention for the Protection of Vertebrate Animals Used for Experimental and Scientific Purposes. Digital data were processed statistically using computer programs "Statystyka" and MS Office 2007.

Results and discussion. The control group of rabbits received the basic diet, which provided the need of animals for nutrients, vitamins,

macro- and microelements. For the animals of the research groups we developed a recipe of experimental granulated compound feed according to the European norms for the intensive growth of young rabbits (European table of nutrition of feed for rabbits 2002 EGRAN). The structure of the recipes is given in Table 2.

2. Structure of compound feed recipes for feeding experimental rabbits, % natural feed

Fodder components	Recipes No			
	I control	II exp.	III exp.	IV exp.
Oat grits	18.0	18.0	8.0	-
Barley grits	17.0	17.0	7.0	-
Wheat grits	15.00	2.5	-	-
Triticale grits	-	12.5	35.0	50.0
Soy cake 41 %	5.00	5.00	5.00	5.00
Sunflower meal 35 %	16.0	16.00	16.00	16.00
Alfalfa flour	25.00	25.00	25.00	25.00
Enzyme preparation	-	0.5	0.5	0.5
Premix	4	3.5	3.5	3.5
Total %	100	100	100	100
Content in 1 kg of compound feed:				
Dry matter, kg	0.920	0.920	0.920	0.920
Exchange energy, MJ	10.2	10.4	10.4	10.0
Crude protein, g	170.0	175.0	175.7	160.2
Crude fiber, g	112.5	112.2	112.0	111.4
The cost of compound feed, UAH/100 kg	490	525	580	620

The analysis of the given compound feed recipes shows that the rations for experimental young rabbits were balanced according to the main indicators of nutrition.

In particular, 1 kg of ready-made granulated compound feed contained 10.0–10.4 MJ of exchangeable energy, 160.2–175.7 g of crude protein, 111.4–122.5 g of crude fibre. These fluctuations are not significant and did not affect the results of the study.

Listed in table 3 research results indicate that the use of complete-ration granulated compound feed with a content of 12.5% of Poliske 7 triticale grain significantly increases the digestibility coefficients of

compound feed nutrients: organic matter – by 2.5%, crude fat – by 2.8%, raw fibre – by 6.5%, crude protein – by 3.5 (P<0.05) and Nitrogen-Free Extractive Substances (NFES) – by 4.5% compared to the control group.

3. Coefficients of digestibility of nutrients by the introduction of different amounts of triticale grain (M±m, n=4)

Indicators	Group			
	I control	II exp.	III exp.	IV exp.
Organic matter	70.8±0.29	72.6±0.62	72.1±0.56	71.1±0.46
% to control	-	+2.5	+1.8	+0.4
Crude protein	71.9±0.42	74.4±0.62*	73.1±0.38	72.7±0.36
% to control	-	+3.5	+1.7	+1.1
Crude fat	77.6±0.33	79.8±0.64	78.2±0.57	77.8±0.44
% to control	-	+2.8	+0.8	+0.3
Crude fibre	32.5±1.16	34.6±1.69	33.5±1.52	33.0±1.15
% to control	-	+6.5	+3.1	+1.5
NFES	80.1±0.27	83.6±0.65	82.8±0.62	81.6±0.42
% to control	-	+4.5	+3.4	+1.9

Note: In this and the following tables, the probability of differences between the control and the experiment * – P<0,05; ** – P<0,01.

In the III and IV (35 and 50% replacement with triticale grain) experimental groups, there is also a tendency to increase the digestibility coefficients of nutrients compared to the control group, however, no statistically significant difference between the indicators has been established.

The most advanced method that allows to determine the qualitative transformation of nutrients in the body under the influence of the feed factor is the study of the nitrogen balance, which is the main element of nitrogen metabolism. The increase or decrease in protein content in the body is calculated based on the amount of nitrogen retained in the body (Table 4).

The results of the physiological experiment showed that the use by the body of nitrogenous substances in feed is uneven. It was found that the intake of nitrogen with the diet exceeded its excretion with feces, that is, its balance was positive in all groups. According to the conducted experiment, it was found that the rabbits of the II research group, which were fed compound feed with a content of 12.5% of triticale grain, digested the nitrogen of the feed better than the counterparts of the control group by 1.39 g or 5.15% (P<0.05) .

It should be noted that the digestibility of nitrogen in the body of animals of the III and IV research groups was also higher by 2.1% or by 0.29 g compared to the control.

4. Average daily nitrogen balance after introducing different amounts of triticale grain (M±m, n=4)

Indicators	Group			
	I control	II exp.	III exp.	IV exp.
Taken with food, g	5.16±0.085	6.35±0.097	6.13±0.091	5.74±0.078
Excreted with faeces, g	2.64±0.021	2.44±0.028	2.48±0.028	2.54±0.025
Digested, g	2.52±0.066	3.91±0.092*	3.65±0.085	3.20±0.072
Excreted in urine, g	1.12±0.017	1.27±0.029	1.23±0.026	1.19±0.019
Retained in the body, g	1.40±0.071	2.64±0.092	2.42±0.079	2.01±0.061
% of taken	38.52	39.87	39.72	39.24
% of digested	47.20	55.95	55.89	55.33

No less important indicators are the ratio of assimilated nitrogen to that taken and digested. In rabbits of the II experimental group, this indicator was the largest – 39.87% and 55.95%, respectively, compared to the control.

The increase in nutrient digestibility coefficients also affected the indicators of animal growth and development: live weight, absolute and average daily gains (Table 5).

Thus, the live weight at the beginning of the experiment was practically the same in rabbits of all groups, and already at the age of 90 days it was higher in the II, III and IV experimental groups by 3.8%, 1.4 and 0.3%, respectively, compared to their counterparts.

The same trend was observed with absolute and average daily increases in live weight.

5. Productive indicators of young rabbits with the introduction of different amounts of triticale grain (M±m, n=4)

Indicators	Group			
	I control	II exp.	III exp.	IV exp.
Live weight at the beginning of the experiment, g	2126.0±46.8	2050.7±41.9	2095.7±37.6	2120.6±32.9
Live weight at the end of the experiment, g	2856.2±44.6	3005.2±78.4	2965.0±45.6	2895.0±88.6
% to control	-	+5.2	+3.8	+1.4
Absolute increase in live weight, g	730.2±1.23	954.5±2.10	869.3±2.05	774.4±1.33
% to control	-	+1.3	+1.2	+1.1
Average daily gain, g	36.5±0.29	47.7±0.82	43.4±1.02	38.7±0.99
% to control	-	+30.7	+18.9	+6.0

Control slaughter of young rabbits (four animals per group) was carried out at the age of 90 days in a specially adapted workshop, according to accepted veterinary and sanitary standards (Table 6).

Listed in table 6 data shows that the weight of the carcass of a freshly slaughtered animal with internal organs in experimental groups of rabbits was 9.3%, 6.8, and 2.4% higher, respectively, than in the control group, and the weight of the carcass of a freshly slaughtered animal without internal organs was also higher by 10.9%, 7.9 and 2.7% in relation to the control.

Slaughter yield in II, III and IV experimental groups was 50.2, 49.5 and 48.3% against 47.6% in the group of control analogues.

12 hours after slaughter, the weight of the cooled carcass was determined. It was the highest in rabbits of the II group (with the replacement of 12.5% of the grain component with triticale grain). In III and IV experimental groups, this indicator was also higher than in the control by 8.2 and 2.8%, respectively. A significant advantage of experimental rabbits in pulp mass was noted – by 21.4%, 15.4 and 5.4%, respectively, by groups.

The mass of visceral fat was lower in all experimental groups of rabbits compared to the control.

6. Carcass weight of rabbits and slaughter yield when fed different amounts of triticale grain (M±m, n=4)

Indicators	Group			
	I control	II exp.	III exp.	IV exp.
Weight of carcass of a freshly slaughtered animal with internal organs, g	1595.0±44.6	1744.0±88.6	1703.7±45.6	1633.8±17.7
% to control	-	+9.3	+6.8	+2.4
Weight of carcass of a freshly slaughtered animal without internal organs, g	1360.2±44.6	1509.0±88.6	1468.5±46.1	1398.0±16.6
% to control	-	+10.9	+7.9	+2.7
Slaughter yield, %	47.6±0.67	50.2±1.44	49.5±0.75	48.3±0.30
Mass of cooled carcass, g	1317.7±95.8	1466.5±88.6	1426.0±46.1	1355.5±16.6
% to control	-	+11.3	+8.2	+2.8
Mass of flesh, g	695.0±28.7	843.8±50.6	802.3±43.9	732.8±32.7
% to control	-	+21.4	+15.4	+5.4
Bone mass, g	473.5±16.1-	622.3±38.5	580.8±19.0	511.3±18.5
% to control		+13.4	+12.2	+7.9
Internal fat mass, g	33.2±1.65	32.5±2.75	30.0±4.5	31.0±0.91
% to control	-	-10.2	-10.6	-10.7

During the examination of the internal organs of the slaughtered rabbits, no significant deviations from the norm were found, although some tend to their increase was observed (Table 7).

The obtained data on the mass of internal organs (liver, spleen, kidneys, lungs, heart) indicate that their mass was higher in rabbits of the II, III and IV experimental groups, in particular, the liver – by 6.3%, 5.8 and 4.5%, spleen – by 6.8%, 5.7 and 2.8%, kidney – by 5.9%, 3.3 and 1.7%, lungs – by 9.2%, 3.8 and 1.5%, heart – by 10.0%, 7.0 and 5.0% compared to control analogues [8].

The chemical composition of rabbit meat differs from the meat of other farm animals – it has a higher content of complete proteins, a lower amount of fat, extractive substances, purine bases and cholesterol. It has good taste and culinary properties, is easily absorbed by the body, therefore it belongs to the category of dietary and is used in the nutrition of people of any age.

7. Weight of internal organs of rabbits fed different amounts of triticale grain (M±m, n=4)

Indicators	Group			
	I control	II exp.	III exp.	IV exp.
Liver, g	89.5±2.02	95.2±1.75	94.7±0.85	93.5±0.64
% to control	-	+6.3	+5.8	+4.5
Spleen, g	1.75±8.66	1.87±0.07	1.85±0.06	1.80±8.16
% to control	-	+6.8	+5.7	+2.8
Kidneys, g	30.2±1.43	32.0±0.81	31.2±0.47	30.7±1.10
% to control	-	+5.9	+3.3	+1.7
Lungs, g	13.0±0.40	14.2±0.47	13.5±0.64	13.2±0.75
% to control	-	+9.2	+3.8	+1.5
Heart, g	10.0±0.40	11.0±0.40	10.7±0.47	10.5±0.64
% to control	-	+10.0	+7.0	+5.0

Conclusions

The use of complete-ration granulated compound feed with a content of 12.5% of Poliske 7 triticale grain increases the digestibility coefficients of compound feed nutrients: organic matter – by 2.5%, crude fat – by 2.8%, crude fibre – by 6.5%, crude protein – by 3.5 ($P<0.05$) and NFES by 4.5% compared to the control.

Rabbits of the II experimental group, which were fed compound feed with a content of 12.5% triticale grain, digested feed nitrogen better than the counterparts of the control group by 1.39 g or 5.15% ($P<0.05$).

The amount of absorbed nitrogen in the rabbits' bodies was greater in II, III and VI experimental groups by 1.24 g (8.57%), 1.02 g (5.71 %) and 0.61 g (3.57 %). The ratio of assimilated nitrogen to taken and digested in rabbits of the II research group was the highest – 39.87% and 55.95%, respectively, compared to the control.

The weight of carcasses of freshly slaughtered animals with internal organs in experimental groups of rabbits was by 9.3%, 6.8 and 2.4%, respectively, and the weight of carcasses of freshly slaughtered animals without internal organs was by 10.9%, 7.9 and 2.7% % higher than in the control.

Slaughter yield in II, III and IV experimental groups was 50.2%, 49.5 and 48.3% against 47.6 in the group of control analogues.

Average daily weight gain, as one of the main performance indicators, was higher in rabbits of the II, III and IV experimental groups by 30.7%, 18.9 and 6.0%, respectively, than in the control peers.

The introduction of triticale grain in the amount of 12.5% into the composition of granulated compound feed has a positive effect on the intensity of growth of young rabbits, digestion and assimilation of nutrients, as well as the mass of internal organs.

Список використаної літератури

1. Білітюк А. П., Ісаков В. В., Потапчук Ю. В. Тритикале – кормова білкова культура. *Корми і кормовиробництво*. 2010. Вип. 66. С. 38–43.

2. Єгоров Б. В., Кузьменко Ю. Я. Біологічна оцінка функціональних комбікормів для сільськогосподарської птиці. *Зернові продукти і комбікорми.* 2015. № 1 (57). С. 12–18.

3. Дармограй Л. М., Шевченко М. Є., Лучин І. С. Конверсія комбікорму та продуктивні показники молодняку кролів за різної кількості дріжджів. *Наук. вісник ЛНУВМБТ імені С. З. Ґжицького*. 2014. Т. 16, № 3 (60), ч. 3. С. 91–100.

4. Дармограй Л. М., Шевченко М. Є. Вплив біомаси дріжджів на забійні показники та м'ясні якості кролів. *Вісник Сумського НАУ. Серія «Тваринництво».* 2016. Вип. 5 (29), т. 15. С. 157–160.

5. Коцюбенко Г. А. Науково-практичні методи підвищення продуктивності кролів : монографія. Миколаїв : МНАУ, 2013. 191 с.

6. Васильєва С. В. Народногоподарське значення тритикале та перспективи його використання для розширення сировинної бази харчових виробництв. *Зернові продукти і комбікорми.* 2016. Вип. 62. С. 44–56.

7. Сачук Р.М. Особливості постембріонального розвитку молодняку кролів в залежності від системи утримання. *Наук. вісник ЛНУВМБТ імені С. З. Ґжицького.* 2012. Т. 14, № 3 (53), ч. 2. С. 384–387.

8. Сломчинський М. М., Чернявський О. О. Динаміка маси внутрішніх органів молодняку кролів за згодовування високопротеїнових кормів. *Технологія виробництва і переробки продукції тваринництва*. 2015. № 2. С. 153–156.

9. Abecia L. et al. Biodiversity and

References

1. Bilitiuk A. P., Isakov V. V., Potapchuk Yu. V. Triticale – fodder protein crop. *Kormy i kormovyrobnytstvo*. 2010. Issue 66. C. 38–43.

2. Yehorov B. V., Kuz′menko Yu. Ya. Biological evaluation of functional compound feed for poultry. *Zernovi produkty i kombikormy.* 2015. No. 1 (57). P. 12–18.

3. Darmohray L. M., Shevchenko M. Ye., Luchyn I. S. Conversion of compound feed and productive indicators of young rabbits with different amounts of yeast. *Nauk. visnyk LNUVMBT imeni S. Z. Gzhyts'koho.* 2014. Vol. 16. No. 3 (60), p. 3. P. 91–100.

4. Darmohray L. M., Shevchenko M. Ye. The influence of yeast biomass on slaughter performance and meat qualities of rabbits. *Visnyk Sums'koho NAU. Seriia «Tvarynytstvo».* 2016. Issue 5 (29). T. 15. P. 157–160.

5. Kotsiubenko H. A. Scientific and practical methods of increasing the productivity of rabbits: monograph. 2013. Mykolayiv : MNAU. 191 p.

6. Vasyl′ieva S. V. The importance of triticale as a folk food and the prospects of its use for the expansion of the raw material base of food production. *Zernovi produkty i kombikormy*. 2016. Issue 62. P. 44–56.

7. Sachuk R. M. Peculiarities of the post-embryonic development of young rabbits depending on the housing system. *Nauk. visnyk LNUVMBT imeni S. Z. Gzhyts'koho.* 2012. Vol. 14. No. 3 (53), p. 2. P. 384–387.

8. Slomchyns′kyi M. M., Chernyavs′kyi O. O. Dynamics of the mass of internal organs of young rabbits fed high-protein feed. *Tekhnolohiia vyrobnytstva i pererobky produktsiyi tvarynnytstva*. 2015. No. 2. P. 153–156.

9. Abecia L. et al. Biodiversity and

fermentative activity of caecal microbial communities in wild and farm rabbits from Spain. *Anaerobe.* 2012. Vol. 3. P. 344–349.

10. Abu Hafsa S. H., Mahmoud A. E., Fayed A. M. The Effect of Exogenous Lysozyme Supplementation on Growth Performance, Caecal Fermentation And Microbiota, and Blood Constituentsin Growing Rabbits. *Animals.* 2022. Vol. 12. P. 899. Doi: 10.3390/ani12070899.

11. Adelodun O. Fadare. Carcass Traits of New Zealand White, Californian, Palomino Brown and Havana Black Rabbit In the Humid Tropics. *IOSR Journal of Agriculture and Veterinary Science.* 2015. Vol. 8. Issue 3. P. 19–23. www.iosrjournals.org.

12. Adhikari P. A., Kim W. K. Overview of prebiotics and Probiotics: focus on performance, gut health and immunity – a review. *Annals of Animal Science*. 2017. Vol. 17(4). P. 949–966. DOI: 10.1515/aoas-2016-0092.

13. Alejandro S. d .B., Ana Isabel G.-R., Nuria N. Effect of Type and Dietary Fat Content on rabbit growing Performance and Nutrient Retentionfrom 34 to 63 Days Old. *Animals*. 2021. Vol. 11. P. 3389. DOI: 10.3390/ani11123389.

14. Anous M. R. Growth performance, slaughter and carcass compositional traits in rabbits of a local strain and New Zeland white breed raised in Burundi. *World Rabbit Science.* 2019. Vol. 7 (3). P. 139–143.

15. Belenguer A. et al. Methanogenesis in rabbit caecum as affected by the fermentation pattern: *in vitro* and *in vivo* measurements. *World Rabbit Sci.* 2012. Vol. 19. P. 758–764.

16. Bharathy N., Sivakumar K., Vasanthakumar P. Rabbit Farming in India : An Overview. *Agricultural Reviews.* 2022. (43) P. 223–228. DOI: 10.18805/ag.R-1907.

17. Birolo M. et al. Growth Performance, Digestive Efficiency, and Meat Quality of Two Commercial Crossbred Rabbits Fed Diets Differingin Energy and Protein Levels. *Animals.* 2022. Vol. 12 (18). P. 2427. DOI: 10.3390/ani12182427

18. Bivolarski B., Vachkova E., Ribarski S. Effect of weaning age upon the slaughter and physicochemical traits of rabbit meat. *Veterinarski archive.* 2012. Vol. 81 (4).

fermentative activity of caecal microbial communities in wild and farm rabbits from Spain. *Anaerobe.* 2012. Vol. 3. P. 344–349.

10. Abu Hafsa S. H., Mahmoud A. E., Fayed A. M. The Effect of Exogenous Lysozyme Supplementation on Growth Performance, Caecal Fermentation And Microbiota, and Blood Constituents in Growing Rabbits. *Animals.* 2022. Vol. 12. P. 899. Doi: 10.3390/ani12070899.

11. Adelodun O. Fadare. Carcass Traits of New Zealand White, Californian, Palomino Brown and Havana Black Rabbit In the Humid Tropics. *IOSR Journal of Agriculture and Veterinary Science.* 2015. Vol. 8. Issue 3. P. 19–23. www.iosrjournals.org.

12. Adhikari P. A., Kim W. K. Overview of prebiotics and Probiotics: focus on performance, gut health and immunity – a review. *Annals of Animal Science.* 2017. Vol. 17(4). P. 949–966. DOI: 10.1515/aoas-2016-0092.

13. Alejandro S.d.B., Ana Isabel G.-R., Nuria N. Effect of Type and Dietary Fat Content on rabbit growing Performance and Nutrient Retention from 34 to 63 Days Old. *Animals*. 2021. Vol. 11. P. 3389. DOI: 10.3390/ani11123389.

14. Anous M. R. Growth performance, slaughter and carcass compositional traits in rabbits of a local strain and New Zeland white breed raised in Burundi. *World Rabbit Science.* 2019. Vol. 7 (3). P. 139–143.

15. Belenguer A. et al. Methanogenesis in rabbit caecum as affected by the fermentation pattern: *in vitro* and *in vivo* measurements. *World Rabbit Sci.* 2012. Vol. 19. P. 758–764.

16. Bharathy N., Sivakumar K., Vasanthakumar P. Rabbit Farming in India : An Overview. *Agricultural Reviews.* 2022. (43) P. 223–228. DOI: 10.18805/ag.R-1907.

17. Birolo M. et al. Growth Performance, Digestive Efficiency, and Meat Quality of Two Commercial Crossbred Rabbits Fed Diets Differingin Energy and Protein Levels. *Animals.* 2022. Vol. 12 (18). P. 2427. DOI: 10.3390/ani12182427

18. Bivolarski B., Vachkova E., Ribarski S. Effect of weaning age upon the slaughter and physicochemical traits of rabbit meat. *Veterinarski archive.* 2012. Vol. 81 (4).

meat. *Veterinarski archive.* 2012. Vol. 81 (4). P. 499–511.

19. Bouatene D, Bohoua L, Guichard S. Effect of Moringa oleifera on Growth Perfomance and Helth Status of Young Post-Weaning Rabbits. *Research Journal of Poultry Sciences.* 2014. Vol. 6 (1). P. 7–13.

20. Crovato S. et al. Purchasing Habits, Sustainability Perceptions, and Welfare Concern sof Italian Consumers Regarding Rabbit Meat. *Foods*. 2022. Vol. 11 (9). P. 1205. http://dx.doi.org/10.3390/foods 11091205.

21. Cullere M., Dalle Zotte A. Rabbit meat production and consumption: State of knowledge and future perspectives. *Meat Science*. 2018. Vol. 143. P. 137–146. DOI: 10.1016/j.meatsci.2018.04.029.

22. Fedorchenko M. Influence of vitamin-mineral supplement on protein metabolism in rabbits' organisms. *Ukrainian Journal of Veterinary and Agricultural Sciences.* 2021. Vol. 4 (1). P. 3–6. DOI: 10.32718/ujvas4-1.01

23. Macari A. et. al. Productiv Index of Meat Rabbits of White New Zealand Breed Californian and their Crossbreeds. *Animal Science and Biotechnologies*. 2012. Vol. 45 (2). P. 365–369.

24. Maji D., Bienieki J., Lapal P. The effect of crossing New Zealand White with Californian rabbits on growth and slaughter traits. *Archiv Tierzucht*. 2019. Vol. 52 (2). P. 205–211.

25. Mancini S., Paci G. Probiotics in Rabbit Farming: Growth Performance, Health Status, and Meat Quality. *Animals.* 2021. Vol. 11.
P. 3388. DOI: 10.3390/ani11123388.

26. Mondin C., Trestini S., Trocino A. The Economics of Rabbit Farming: A Pilot Study on the Impact of Different Housing Systems. *Animals.* 2021. Vol. 11(11). P. 3040. DOI: 10.3390/ani11113040.

27. Petrescu D. C., Petrescu-Mag R. M. Consumer behaviour related to rabbit meat as functional food. *World Rabbit Sci.* 2018. Vol. 26. P. 321–333. DOI: 10.4995/wrs.2018.10435.

28. Trocino A. et al. Rabbit production and science: the world and Italian scenarios from 1998 to 2018. *Italian Journal of Animal*

P. 499–511.

19. Bouatene D, Bohoua L, Guichard S. Effect of Moringa oleifera on Growth Perfomance and Helth Status of Young Post-Weaning Rabbits. *Research Journal of Poultry Sciences.* 2014. Vol. 6 (1). P. 7–13.

20. Crovato S. et al. Purchasing Habits, Sustainability Perceptions, and Welfare Concerns of Italian Consumers Regarding Rabbit Meat. *Foods*. 2022. Vol. 11 (9). P. 1205. http://dx.doi.org/10.3390/foods 11091205.

21. Cullere M., Dalle Zotte A. Rabbit meat production and consumption: State of knowledge and future perspectives. *Meat Science*. 2018. Vol. 143. P. 137–146. DOI: 10.1016/j.meatsci.2018.04.029.

22. Fedorchenko M. Influence of vitamin-mineral supplement on protein metabolism in rabbits' organisms. *Ukrainian Journal of Veterinary and Agricultural Sciences.* 2021. Vol. 4 (1). P. 3–6. https://doi.org/10.32718/ujvas4-1.01

23. Macari A. et. al. Productiv Index of Meat Rabbits of White New Zealand Breed, Californian and their Crossbreeds. *Animal Science and Biotechnologies*. 2012. Vol. 45 (2). P. 365–369.

24. Maji D., Bienieki J., Lapal P. The effect of crossing New Zealand White with Californian rabbits on growth and slaughter traits. *Archiv Tierzucht*. 2019. Vol. 52 (2). P. 205–211.

25. Mancini S., Paci G. Probiotics in Rabbit Farming : Growth Performance, Health Status, and Meat Quality. *Animals.* 2021. Vol. 11.
P. 3388. DOI: 10.3390/ani11123388.

26. Mondin C., Trestini S., Trocino A. The Economics of Rabbit Farming: A Pilot Study on the Impact of Different Housing Systems. *Animals.* 2021. Vol. 11(11). P. 3040. DOI: 10.3390/ani11113040.

27. Petrescu D. C., Petrescu-Mag R. M. Consumer behaviour related to rabbit meat as a functional food. *World Rabbit Sci.* 2018. Vol. 26. P. 321–333. DOI: 10.4995/wrs.2018.10435.

28. Trocino A. et al. Rabbit production and science: the world and Italian scenarios from 1998 to 2018. *Italian Journal of Animal Science.* 2019. Vol.18 (1). P. 1361–1371.

Science. 2019. Vol.18 (1). P. 1361–1371. DOI: 10.1080/1828051X.2019.1662739.

29. Vincent J. B., Love S.T. The need for combined inorganic, biochemical, and nutritional studies of chromium (III). *Chem. Biodivers.* 2012. Vol. 9 (9). P. 1923–1941.

30. Wu L. Rabbit meat trade of major countries : regional pattern and driving forces. *World Rabbit Sci*. 2022. Vol. 30. P. 69–82. DOI: 10.4995/wrs.2022.13390.

DOI: 10.1080/1828051X.2019.1662739.

29. Vincent J. B., Love S.T. The need for combined inorganic, biochemical, and nutritional studies of chromium (III). *Chem. Biodivers.* 2012. Vol. 9 (9). P. 1923–1941.

30. Wu L. Rabbit meat trade of major countries : regional pattern and driving forces. *World Rabbit Sci*. 2022. Vol. 30. P. 69–82. DOI: 10.4995/wrs.2022.13390.

Received October 17, 2022
Accepted: October 31, 2022