Scientific Papers. Series D. Animal Science. Vol. LXVII, No. 2, 2024
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

THE INFLUENCE OF L-CARNITINE ON THE PRODUCTIVITY OF YOUNG RABBITS

Hryhoriy SEDILO[1], Ihor LUCHYN[2], Nataliia FEDAK[1], Oksana MAMCHUR[3]

[1]Institute of Agriculture of the Carpathian Region, National Academy of Agricultural Sciences of Ukraine, 81115, 5 Hrushevskoho Street, Obroshyne Village, Lviv Region, Ukraine
[2]Cherkasy Research Station of Biological Resources, National Academy of Agricultural Sciences of Ukraine, 18036, 76 Pasteur Street, Cherkasy, Ukraine
[3]Ivan Franko National University of Lviv, 79000, 1 Universytetska Street, Lviv, Ukraine

Corresponding author email: oksana.mamchur@lnu.edu.ua

Abstract

In the studies, the bioadditive "CarnEon 50" was used, recommended for optimizing the intensive fattening of young monogastric animals to balance their ration with carnitine effectively. The research aimed to find out the effectiveness and safety of the use of a bio-additive as an element of intensive rabbit meat production. Research methods - zootechnical, laboratory, statistical. A compound feed recipe based on local feed ingredients was developed for intensive fattening of young rabbits of the newly created chinchilla-like type. It was established that the addition of "CarnEon 50" to the diet of fattening young rabbits in the amount of 150, 200 and 250 g/t increased their productivity at the age of 90 days, in particular, live weight - by 2.9-6.8%, average daily gains - by 4.2-10.5%, lifetime waist width (an indicator of meatiness) by - 3.04.5%, feed conversion improved by 2.5-3.9%. It is shown that the use of a bioadditive in the amount of 200-250 g/t of compound feed in the rations of young rabbits during intensive production of rabbit meat makes it possible to reduce direct costs for the production of 1 ton of rabbit meat by 20,94 USD and increase the profitability of production by 2%.

Key words: *bioadditive, fattening and slaughter indicators, intensive rabbit breeding, integrated assessment index, local fodder.*

INTRODUCTION

Modern industrial rabbit breeding is a source of valuable dietary meat, fur, leather, etc. (Petrescu & Petrescu-Mag, 2018). This is one of the most promising livestock industries, as rabbits are characterized by high fertility, early maturity, lack of seasonality in reproduction, intensive growth of young animals, and have one of the highest feed conversion rates among farm animals (Bashchenko & Luchyn, 2019; Wu, 2022). To obtain high rabbit productivity, it is important to use breeds and mixtures with high genetic productivity potential (Bojko et al., 2022) and take all necessary technological measures to realize this potential: a complete and balanced diet, controlled conditions of detention, etc. (Colin, 1993; Bashchenko et al., 2020). One of the ways to solve the problem of dietary balance is to use biologically active substances in the process of feed production, which will ensure high-quality rabbit production with the use of traditional ingredients as feed additives. They include vitamins and minerals, the absence of which in the diet leads to diseases and growth inhibition; amino acids, in particular lysine and methionine, which regulate protein metabolism (Belenguer et al., 2005); probiotics, antioxidants (Dalle Zotte & Szendro, 2011); biologically active substances of plants that have a positive effect on the gastrointestinal system, etc. (Mancini & Paci, 2021; Sedilo et al., 2022). L-carnitine performs key functions in animal metabolism, in particular, it plays an essential role in fatty acid metabolism (Flanagan et al., 2010). In intensive livestock farming technologies, L-carnitine has a multifunctional purpose, which includes: growth stimulation, improvement of the immune system, antioxidant effects, etc. (Ringseis et al., 2018b; Liu et al., 2020). Under the influence of carnitine in the diet of lactating cows, an improvement in hematological blood parameters was found (Kononov et al., 2021; Kononov et al., 2022); studies (Meyer et al., 2021; Danesh Mesgaran et al., 2021; Ghaffari, 2021) showed an improvement in the immune status and a decrease in the level of inflammation in cows during active

lactation. The use of carnitine supplementation had a positive effect on nitrogen metabolism (Ringseis et al., 2018a), meat quality, and piglet growth in intensive feeding (Chen et al., 2008). The authors (Golzar et al., 2011) have comprehensively described the functional effects of carnitine under intensive chicken-rearing technologies. There are few data on the effect of carnitine on rabbit performance, in particular, the hepatoprotective effect of carnitine under conditions of parenteral administration is described (Ebeid et al., 2023), and the positive effect of carnitine in high-energy diets on feed conversion and blood parameters of rabbits is revealed (Ayyat et al., 2021).

Thus, the study of the peculiarities of application, the study of the productive effect and safety of various feed additives in rabbit fattening remains relevant. That is why the aim of the research was to substantiate and develop a scheme for the use of "CarnEon 50", to determine the optimal doses of this additive in the diets of young rabbits of chinchilla type for intensive cultivation, its effect on productivity, lifetime meatiness and slaughter yield of animals, to establish the degree of feed conversion, safety of use, profitability and economic efficiency in feeding young rabbits.

MATERIALS AND METHODS

The study of the effect of L-carnitine in the composition of the dietary supplement "CarnEon 50" on the metabolism of young rabbits of three-breed crossbreeds of Chinchilla, Flandr, and Termon white (a newly created type of Chinchilla, NCCT) was carried out at the Carpathian State Agricultural Research Station of the Institute of Agriculture of the Carpathian Region of the NAAS using intensive rabbit production technologies (Bojko et al., 2022). For this purpose, 6 groups of young rabbits aged 25 days, 10 animals in each group (5 males + 5 females) with an average weight of 494-512 g were formed by the method of pair analogues (Table 1).

The preparatory period of the experiment lasted 5 days, the main investigations were carried out for 60 days by comparative analysis of the growth intensity of young rabbits from 30 to 90 days of age based on the determination of absolute, relative and average daily growth; feed conversion, lifetime meat and slaughter indicators.

Table 1. Experiment scheme

Group	Nature of feeding young rabbits (NCCT), n = 10
1 (control)	Basic diet (BD), without dietary supplements
2 (experimental)	BD + 100 g CarnEon 50» per 1 tonne of finished feed
3 (experimental)	BD + 150 g CarnEon 50» per 1 tonne of finished feed
4 (experimental)	BD + 200 g CarnEon 50» per 1 tonne of finished feed
5 (experimental)	BD + 250 g CarnEon 50» per 1 tonne of finished feed
6 (experimental)	BD + 300 g CarnEon 50» per 1 tonne of finished feed

The feeding technology is complete granulated feed with free feeding. Local ingredients were used in the basic diet (BD): barley turf (10%), oat turf (10%), wheat bran (10%), sunflower meal (20%), alfalfa flour (35%), table salt (0.4%), and premix (3.1%). 1 kg of this fodder costing 0.29 USD contains 0.88 kg of dry matter, 175.0 g of crude protein and 160.0 g of crude fibre, providing animals with 9.19 MJ of metabolizable energy. The diets for fattening young animals during the experiment were calculated by structuring fodder according to European standards for intensively growing young rabbits (Maertes et al., 2004).

L-carnitine in the form of the biological additive "CarnEon 50" was pre-mixed thoroughly with the premix and introduced into the fodder mixture according to the experimental scheme.

The biological additive CarnEon 50 used in the study contains carnitine (48-52%) and calcium carbonate. It enriches animal, poultry, and fish feed with L-carnitine, as its endogenous synthesis covers up to 25% of the daily animal requirement. In contrast, the carnitine content in plant-based fodder is insignificant (Golzar et al., 2011).

The research was conducted by modern methodological approaches and in compliance with relevant requirements and standards, in particular, they met the requirements of DSTU ISO/EC 17025:2006 (ISO/IEC 17025:2005, IDT). The animals were kept and all manipulations with them were carried out by the provisions of the "General Ethical Principles for Animal Experiments" adopted by the First

National Congress on Bioethics and the "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes" (European convention, 1986).

To determine the objective value of fattening and meat qualities of experimental animals, the comprehensive assessment indicator (CAI) was calculated (Luchyn, 2005) by applying indicators of average daily weight gain and lumbar width using the equation:

$$CAI=5.1(K+2H) \quad (1)$$

where CAI – comprehensive assessment indicator; 5.1 and 2 – correction factors; K – average daily increase in live weight of young animals for the growing period, g;

H – width of the lower back, cm.

The economic and technological efficiency of the use of L-carnitine in the form of the biological additive "CarnEon 50" in intensive rabbit production was determined according to generally accepted methods (Mondin et al., 2021).

All the results obtained were interpreted using the methods of variation statistics and the calculation of probability criteria using Excel 2007.

RESULTS AND DISCUSSIONS

Rabbit nutrition involves several mechanical, chemical, and microbiological processes that ensure the consistent destruction, absorption, and uptake of feed nutrients. The nutrition of young rabbits has certain age-specific characteristics. For example, the formation of the digestive tract's ability to consume plant feed is complete at three months of age. This process is stimulated by adding several biologically active substances to the rabbit diet, including carnitine.

To study the safety and efficacy of different doses of carnitine in the diet of young rabbits of three-breed crossbreeds and the effect on their productivity, analog animals were selected by weight at the age of 25 days, which during the preparatory period of 5 days were fed a diet enriched with carnitine according to the experimental scheme (Table 1). During the preparatory period, the animals adapted to the experimental diet enriched by different amounts of carnitine. There was a tendency to change the intensity of growth of young rabbits in the experimental groups (Table 2).

Table 2. Live weight of experimental animals during the preparatory period of research (m ± m, n = 10)

Group	When setting up for the preparatory period (25 days)	After the end of the preparatory period (30 days)
1 (control)	502±13.46	714±14.39
2 (experimental)	499±14.28	717±10.28
3 (experimental)	512±14.46	707±10.67
4 (experimental)	494±11.73	687±14.05
5 (experimental)	506±12.72	693±13.67
6 (experimental)	497±13.62	677±14.53

It was found that during the preparatory period, with an increase in the amount of carnitine in the diets, the average daily weight gain of animals decreased slightly, in particular, the weight gain of rabbits of the third, fourth, fifth, and sixth experimental groups was 27.5; 27.6, 26.7 and 25.7 g, respectively, which was 9.2, 8.9, 11.8 and 15.2% less than the rabbits of the control group, whose weight gain was 30.3 g, thus the adaptation of young rabbits to the experimental conditions was optimal.

To determine the effectiveness of the use of the bioadditive "CarnEon 50" on the productive characteristics of young rabbits, the average live weight of animals at 90 days of age was evaluated using different doses of carnitine for 60 days. It was shown that optimization of the diet of young rabbits by adding different doses of carnitine had a positive effect on the average live weight of animals in all experimental groups (Table 3).

Table 3. Growth rate of young rabbits (M ± m, n = 10)

Group	Live weight of 1 animal		Average daily rates increments, g
	at 30 days of age, g	at 90 days of age, g	
1 (control)	714±14.39	2692±39	36.0±0.8
2 (experimental)	717±10.28	2715±47	36.3±0.9
3 (experimental)	707±10.67	2770±39	37.5±0.8
4 (experimental)	687±14.05	2875±37*	39.8±0.7*
5 (experimental)	693±13.67	2840±52*	39.0±1.0*
6 (experimental)	677±14.53	2705±53	36.9±1.1

Note: *p<0.05.

The maximum live weight of one individual at 90 days of age was in groups 4 and 5 with the

use of 200 and 250 g/t of carnitine supplementation, respectively, and was 2875 and 2840 g compared to 2692 g in the control, i.e. an increase in the live weight of rabbits of both groups by 7% was recorde.

An important objective characteristic for assessing the effectiveness of dietary supplements, especially in conditions of intensive rabbit production, is the value of average daily live weight gain because this indicator makes it possible to establish the nature of the impact of changes in the diet on rabbit productivity. The highest average daily weight gain for 30-90 days was observed in animals of the fourth and fifth groups, with the use of 200 and 250 g/t of carnitine supplementation - 39.8 and 39.0 g, which is 11 and 10% higher than in the control group, respectively, slightly lower were these indicators in rabbits of the third and sixth experimental groups, with the use of 150 and 300 g/t of carnitine supplementation - 37.5 and 36.9 g, which exceeds the corresponding increases in the control group by 2.5 and 4.1%, respectively. At the same time, the average daily weight gain of animals in the second group was within the control values, and the average daily weight gain in the fourth and fifth groups of young rabbits had a significant difference from the control ($p<0.05$).

An important characteristic of the feeding productivity of young rabbits under intensive fattening technologies is the width of the lower back - an important vital index that allows to assess the potential of meatiness of animals and, if necessary, to adjust the diet to ensure maximum animal productivity determined by genotype. According to the data in Table 4, the width of the lower back in rabbits at 3 months of age increased slightly with the optimization of the diet with different doses of carnitine and was highest in animals of the fourth group receiving 200 g/t of carnitine supplementation, where it was 6.9 cm, which is 5% more than in the control.

When the diet of experimental rabbits was optimized with lower and higher doses of carnitine in the composition of the additive "CarnEon 50" in the amount of 100, 150, 250, and 300 g per tonne of finished feed, the lifetime lumbar width of experimental animals did not differ significantly from the control (Table 4).

Table 4. Fattening and slaughter indicators of young rabbits at 90-day age, (m ± m, n = 10)

Group	Width of lower back, cm	Weight of a paired carcass, g	Slaughter output, %	Feed costs per 1 kg of growth, kg	CAI
1 (control)	6.6±0.1	1336±17	49.5	3.85	251
2 (experimental)	6.7±0.11	1362±25	50.2	3.85	253
3 (experimental)	6.8±0.07	1406±19	50.7	3.75	261
4 (experimental)	6.9±0.07	1460±18**	50.8	3.7	273
5 (experimental)	6.8±0.09	1433±24**	50.5	3.7	268
6 (experimental)	6.6±0.08	1362±24	50.4	3.8	255

Note: **$p<0.01$.

The analysis of slaughter indicators, such as the weight of a paired carcass, showed a somewhat uneven increase in the animals of the experimental groups. Thus, the young rabbits of the third, fourth, and fifth groups, which received 150, 200, and 250 g/t of carnitine supplementation, outperformed the animals of the control group by 70, 124, and 94 g, respectively. Animals of the second and sixth groups, whose diets were enriched with 100 and 300 g/t of carnitine supplementation, slightly outperformed the control group in terms of paired carcass weight.

The slaughter output of young rabbits, an important qualitative characteristic of intensive rabbit breeding, positively changed in all experimental groups. Analysis of the slaughter output of young rabbits showed an advantage of animals of the third, fourth and fifth groups over animals of the control group by 1.0-1.3%.

Fodder costs for intensive technologies of fattening young rabbits are determined by the characteristics of animal metabolism and are a factor in the efficiency of feed conversion. The analysis of the cost of finished fodder per unit of gain showed effective feed assimilation by

animals of the fourth and fifth groups, whose diet was enriched with 200 and 250 g/t of carnitine supplementation, as feed consumption was only 3.70 kg, which is 4% lower than in the control. Animals in the third group, which received 150 g/t of carnitine supplementation, consumed 3.75 kg of feed compared to 3.85 kg of animals in the control group. Feed consumption in animals of the second and sixth groups, whose diets were enriched with 100 and 300 g/t of carnitine supplementation, was 3.85 kg and 3.80 kg, which was at the level of the control.

Improving the metabolism of rabbits due to the use of different doses of carnitine supplementation in the diet of intensive fattening of young animals naturally led to an increase in the comprehensive assessment indicator (CAI), which is calculated based on the average daily weight gain and lumbar width. The highest values of this indicator were obtained for young animals of the fourth and fifth groups, which received 200 and 250 g/t of carnitine supplementation, respectively, and amounted to 273 and 268, while for animals of the control group, this indicator was 251.

Thus, the use of carnitine supplementation in the diet of fattening young rabbits at doses of 150, 200 and 250 g per tonne of finished feed increased live weight by 2.9-6.8% at 90 days of age, average daily gain by 4.2-10.5%, lifetime loin width (meatiness) by 3.0-4.5%, and feed conversion improved by 2.5-3.9% compared to the control.

Table 5. Economic efficiency of using different amounts of bioadditive "CarnEon 50" in feeding young rabbits

Economic indicators	Group					
	1	2	3	4	5	6
The cost of 1 kg of dietary supplement, USD	-	39.27	39.27	39.27	39.27	39.27
The cost of 1 tonne of mixed feed, USD.	287.99	291.91	293.88	295.84	297.80	299.77
Feed costs per 1 kg of weight gain, kg	3.85	3.85	3.75	3.7	3.7	3.8
The cost of feed per 1 kg of live weight gain, USD	1.11	11.12	1.10	1.09	1.10	1.14
Cost of 1 kg of rabbit meat, USD	1.58	1.61	1.57	1.56	1.56	1.63
Sales price of 1 kg of live weight of rabbit meat, USD	2.09	2.09	2.09	2.09	2.09	2.09
Net income 1 kg of rabbit meat, USD.	0.51	0.49	0.52	0.53	0.53	0.46
Profitability, %	32	30	33	34	34	29

The best indicators of fattening productivity at 90 days of age were obtained with the addition of 200 g of "CarnEon 50" per tonne of finished fodder, probably due to the effectiveness of the physiological effect of carnitine on the digestion and metabolism of monogastric herbivores, which was manifested in better feed intake. The live weight of rabbits in this experimental group increased by 183 g, average daily weight gain by 3.8 g, loin width by 0.3 cm, and feed conversion improved by 150 g.

Optimization of the diet of young rabbits under intensive fattening conditions by adding different amounts of L-carnitine as part of a dietary additive led to positive changes in animal prodctivity but also caused a rise in fodder prices.

That is why an economic analysis of the effectiveness of the use of bio-additive with L-carnitine as a component of the intensive technology of rabbit meat production was conducted. The data of the economic analysis, presented in Table 5, show that feed costs per 1 kg of growth slightly decreased in all experimental groups (by 4%) compared to the control, except for 2 experimental groups of animals, where the level of feed costs remained unchanged compared to the control values. At the same time, a natural increase in the cost of 1 ton of ready-made feed was found in all experimental groups (from 287.99 USD to 299.77 USD), caused by the optimization of feed nutrition due to the addition of different doses of bio-additive.

The use of "CarnEon 50" bioadditive increased the fattening productivity of rabbits with a simultaneous decrease in the cost of feed per 1 kg of growth by 2-5%, the exception was the sixth group of rabbits that received a diet enriched with 300 g/t of the additive, for which an increase in the cost of 1 kg of feed was noted by 1.5%. Similar data were obtained for the cost of feeding young rabbits, which decreased in all experimental groups compared to control animals (from 1.58 to 1.56 USD), the exception

was the cost of feeding animals of the sixth group, which amounted to 1.63 USD.

The increase in the cost of feed and the cost of feeding rabbits naturally affected the indicators of net profit and profitability of production. The highest profitability of production based on direct costs was recorded for animals of the fourth and fifth groups and amounted to 34%. In addition, the animals of these groups had better performance indicators, which allows us to recommend the doses of "CarnEon 50" bioadditive with carnitine of 200 and 250 g/t as an important element of intensive production of rabbit breeding products.

Thus, optimization of the rations of young rabbits under the conditions of intensive production of rabbit meat by adding to the basic compound feed "CarnEon 50" bioadditive in doses of 200 and 250 g/t makes it possible to make the production of rabbit meat more efficient. At the same time, direct costs for the production of 1 ton of rabbit meat are reduced by 20.94 USD, and the profitability of production increases by 2%.

A characteristic feature of the metabolism of young rabbits of the chinchilla type is a high daily increase in live weight, which occurs due to the effective conversion of feed, but may be accompanied by an imbalance in the conversion of feed and disruption of the work of the gastrointestinal tract, since under certain circumstances this can lead to the development of enteritis, and, respectively, to a decrease in productivity (Petrescu & Petrescu-Mag, 2018; Bashchenko et al., 2020).

Adjustment of metabolism in such a case is a prerequisite for intensive production of rabbit meat and is carried out, first of all, by optimizing rations, as well as improving housing conditions, etc. (Belengueret, 2005; Wu, 2022). The main source of energy for rabbits is the carbohydrates and fats of the feed, while young animals use the energy of the feed nutrients more intensively. In particular, during the day in the body of a 60-75-day-old rabbit, about 1/3 is deposited in protein, 2/3 in fat - 2/3 of the energy of nutrients, and in a 90-105-day-old rabbit - 1/4 and 3/4, respectively (Bashchenko & Luchyn, 2019).

Carnitine plays an important role in energy metabolism by supporting the transport of activated fatty acids to the subcellular site of β-oxidation. In particular, the administration of exogenous carnitine can limit the use of fatty acids as substrates for mitochondrial oxidation, especially when there is an increased energy demand (Flanagan, 2010). L-carnitine supplements are effective in critical periods of animal development, such as intrauterine development, lactation, and intensive growth of young animals. The concentration of L-carnitine in animals varies considerably between species, depending on the type of tissue and nutritional level (Ebeid et al., 2023).

In particular, in poultry farming, L-carnitine has a multifunctional purpose, which includes: growth stimulation, strengthening of the immune system, antioxidant effect, and improvement of poultry productive qualities (Golzar et al., 2011). The effect of carnitine on erythro- and thrombopoiesis has been shown, and an increased oxygen demand has been noted, which is associated with the effect of stabilizing cell membranes (Liu et al., 2020).

The addition of carnitine to the ration of lactating cows caused changes in the mRNA transcription of some genes associated with mitochondrial biogenesis and low-density lipoprotein synthesis, thereby accelerating liver regeneration processes and contributing to the optimization of fatty acid metabolism in animals (Ghaffari, 2021).

In the literature, there is a lot of data on the effect of exogenous carnitine, both in the diet and by parenteral administration, on improving the productivity of farm animals, but the results are very controversial (Ayyat et al., 2021; Chen et al., 2008; Ringseis et al., 2018a). That is why, when using carnitine as a feed additive, it is necessary to take into account the carnitine status of animals, which directly depends on the homeostasis of this acid in the body and includes endogenous synthesis, intake and absorption of carnitine from the gastrointestinal tract and ways of its excretion from the body (Ringseis et al., 2018b).

Many studies show that carnitine is bioavailable to animals, both ruminants and monogastrics, even as a dietary supplement, but its effect on milk or meat production is not always observed, and correlates with endogenous carnitine levels and the stage of ontogeny of the animal. However, supplementation with carnitine is a useful strategy to protect against excessive

ammonia caused by the consumption of unbalanced feeds high in non-protein nitrogen or feeds high in soluble nitrogen (Kononov et al., 2022).

The positive effect of carnitine supplementation is associated, in particular, with a decrease in the level of unesterified fatty acids in blood plasma, an increase in the level of eosinophils, which indicates an increase in the regenerative properties of tissues. The potential impact of L-carnitine supplementation on immune cell function, blood cortisol concentrations, and proliferation has also been established (Kononov et al., 2021).

The inclusion of L-carnitine in the ration of highly productive Holstein dairy cows as part of the rumen enzyme-resistant preparation "Carneon 20 Rumin-Pro" contributed to an increase in their milk production and milk quality compared to the control group. The administration of L-carnitine to these cows reduced the concentration of high and low density lipoproteins in the peripheral blood. To some extent, this can be explained by the ability of L-carnitine to modulate energy metabolism and liver function (Danesh Mesgaran et al., 2021).

A several authors have studied the effect of adding L-carnitine to normal and high-energy diets of young rabbits reared under severe heat stress conditions on their productivity, physiological parameters and carcass characteristics. A significant improvement in the physiological and biochemical parameters of animals, an increase in their growth parameters and the degree of feed conversion was established. These animals showed significantly higher levels of haemoglobin, leukocytes, total protein, and glucose compared to the control, which indicates the safety and effectiveness of carnitine use when rearing them under stressful conditions (Ayyat et al., 2021; Flanagan, 2010).

CONCLUSIONS

The use of an additive with carnitine "CarnEon 50" in the main diet of intensive fattening of chinchilla-like young rabbits in doses of 150, 200, and 250 g per tonne of finished feed led to an increase in the live weight of 90-day-old animals by 2.9-6.8%, average daily gain by 4.2-10.5%, and lifetime loin width (meatiness) by 3.0-4.5%. Feed conversion improved by 2.5-3.9% compared to the control.

Animals whose diets were optimized with carnitine supplementation at doses of 200 and 250 g/t outperformed the control animals by 124 and 94 g ($p<0.01$), and the slaughter yield of young rabbits of these groups was 1.0-1.3% higher than the control.

Using 200 and 250 g/t of carnitine additive in rabbit fattening technology reduced feed costs to 3.70 kg of finished feed per 1 kg of weight gain compared to 3.85 kg in the control.

The use of the additive "CarnEon 50" in the amount of 200-250 g/t of feed in the diets of young rabbits for intensive rabbit production allows to reduce direct costs for the production of 1 ton of rabbit meat by 20,94 USD and increase the profitability of production by 2 %.

Thus, the optimization of the diet of young rabbits of chinchilla type for intensive rabbit production by adding 200 and 250 g/t of additive to the feed contributed to the improvement of lifetime meatiness and slaughter yield with a simultaneous reduction in feed costs and an increase in its conversion, which reduced the cost of rabbit production. The use of carnitine as a component of intensive fattening contributed to an increase in the resistance of young rabbits to gastrointestinal diseases and ensured the absence of animal mortality during the study.

REFERENCES

Ayyat, M.S., Abd El-Latif, K.M., Helal, A.A., & Al-Sagheer A.A. (2021). Interaction of supplementary L-carnitine and dietary energy levels on feed utilization and blood constituents in New Zealand White rabbits reared under summer conditions. *Trop Anim Health Prod*, 53, 279.

Bashchenko, M.I., Honchar, O.F. & Boyko, O.V. (2020). *Rabbit breeding in Ukraine*. Kiev, U: GlobeEdit Publishing House [in Ukrainian].

Bashchenko, M.I., & Luchyn, I.S. (2019). *Designing intensive production of rabbit meat in Ukraine*. Lvov, U: Cherkasy Publishing House. [in Ukrainian].

Belenguer, A., Balcells, J., Guada, J.A., Decoux, M. & Milne, E. (2005). Protein recycling in growing rabbits: contribution of microbial lysine to amino acid metabolism. *Br. J. Nutr.*, 94(5), 763–770.

Bojko, O., Perih, D., Honchar, O., & Luchyn, I. (2022). Efficiency of using industrial crossbreeding to increase rabbits meat productivity. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies. Series: Agricultural Sciences*, 24(97), 110–116.

Chen, Y.J., Kim, I.H., Cho, J.H., Yoo, J.S., Wang, Q., Wang, Y., & Huang, Y. (2008). Evaluation of dietary L-carnitine or garlic powder on growth performance, dry matter and nitrogen digestibilities, blood profiles, and meat quality in finishing pigs. *Animal Feed Science and Technology*, 141(1–2), 141–152.

Colin M. (1993). Rabbit production in East European countries. *World Rabbit Sci.*, 1(1), 37–52.

Dalle Zotte, A., & Szendro, Z. (2011). The role of rabbit meat as functional food. *Meat Science*, 88(3), 319–331.

Danesh Mesgaran, M., Kargar, H., Danesh Mesgaran, S., & Javadmanesh, A. (2021). Peripartal Rumen-Protected L-Carnitine Manipulates the Productive and Blood Metabolic Responses in High-Producing Holstein Dairy Cows. *Frontiers in Veterinary Science*, 8, 769837.

Ebeid, T.A., Aljabeili, H.S., Al-Homidan, I.H., Volek, Z., & Barakat, H. (2023). Ramifications of Heat Stress on Rabbit Production and Role of Nutraceuticals in Alleviating Its Negative Impacts: An Updated Review. *Antioxidants*, 12, 1407.

European convention for the protection of vertebrate animals used for experimental and other scientific purposes (1986). Council of Europe, Strasbourg.

Flanagan, J.L., Simmons, P.A., Vehige, J., Dp Willcox, M, & Garrett, Q. (2010). Role of carnitine in disease. *Nutr. Metab.*, 7, 30.

Ghaffari, M.H. (2021). Effects of dietary L-carnitine supplementation on the response to an inflammatory challenge in mid-lactating dairy cows: hepatic mRNA abundance of genes involved in fatty acid metabolism. *Mendeley Data*, V1.

Golzar, A., Dabi, S.H., Cooper, R.G., Ceylan, N., & Corduk, M. (2011). L-carnitine and its functional effects in poultry nutrition. *World's Poultry Science Journal*, 67.

ISO/IEC 17025:2005, IDT.

Kononov, S.U., Meyer, J., Frahm, J., Kersten, S., Kluess, J., Meyer, U., Huber, K., & Dänicke, S. (2021). Effects of Dietary L-Carnitine Supplementation on Platelets and Erythrogram of Dairy Cows with Special Emphasis on Parturition. *Dairy*, 2, 1–13.

Kononov, S.U., Meyer, J., Frahm, J., Kersten, S., Kluess, J., Meyer, U., Huber, K., & Dänicke, S. (2022). Dietary L-Carnitine Affects Leukocyte Count and Function in Dairy Cows Around Parturition. *Front Immunol.*, 13, 784046.

Liu, G., Ding, Y., Chen, Y., & Yang, Y. (2020). Effect of energy intake and L-carnitine on fattening performance, carcass traits, meat quality, blood metabolites, and gene expression of lamb. *Small Ruminant Research*, 183, 106025.

Luchyn, I. S. (2005). Complex indicator of evaluation of repair young rabbits of different genotypic combinations. *Animal breeding and genetics*, 39, 128–133. [In Ukrinian].

Maertes, L., Peres, J.M., Villamide, M., Cervera, C., Gidene, T. & Xiccato, G. (2004). Nutritive value of raw materials for rabbits: EGRAN tables 2004. *World Rabbit Science*, 10(4), 157–166.

Mancini, S.; & Paci, G. (2021). Probiotics in Rabbit Farming: Growth Performance, Health Status, and Meat Quality. *Animals*, 11, 3388.

Meyer, J., Kononov, S.U., Grindler, S., Tröscher-Mußotter, J., Alaedin, M.T., Frahm, J., Hüther, L., Kluess, J., Kersten, S., von Soosten, D.,..Danicke Sven. (2021). Dietary L-Carnitine Supplementation Modifies the Lipopolysaccharide-Induced Acute Phase Reaction in Dairy Cows. *Animals*, 11, 136.

Mondin, C., Trestini, S., Trocino, A., & Di Martino, G. (2021). The Economics of Rabbit Farming: A Pilot Study on the Impact of Different Housing Systems. *Animals*, 11(11), 3040.

Petrescu, D.C., & Petrescu-Mag, R.M. (2018). Consumer behaviour related to rabbit meat as functional food. *World Rabbit Sci.*, 26, 321–333.

Ringseis, R., Keller, J., & Eder, K. (2018). Basic mechanisms of the regulation of L-carnitine status in monogastrics and efficacy of L-carnitine as a feed additive in pigs and poultry. *J. Anim. Physiol. Anim. Nutr.,* 102, 1686–1719.

Ringseis, R., Keller, J., & Eder, K. (2018). Regulation of carnitine status in ruminants and efficacy of carnitine supplementation on performance and health aspects of ruminant livestock: a review. *Archives of Animal Nutrition,* 72(1), 1–30.

Sedilo, H., Luchyn, I., Fedak, N., & Mamchur, O. (2022). Influence of plant biological additive on the productivity of young rabbits. *Scientific Horizons*, 25 (10), 9–16.

Wu, L. (2022). Rabbit meat trade of major countries: regional pattern and driving forces. *World Rabbit Sci,* 30, 69–82.