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Nettle hay meal feeding and development of replacement pig stock

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The effect of different amount of nettle hay meal replacing concentrated feed on the development of replacement pig stock in terms of live weight and external measurements are studied. Indicators of growth patterns, nutrient consumption per 1 kg of pigs under test are cinsidered as well. Hematological indicators were researched. The main group of pigs was fed with the basic diet in the comparative and main periods of the experiment. (barley, wheat, pea and corn grits and sunflower meal). Nettle hay meal was added to the diet of the second group under test. It replaced 12.5 % of the protein of the above-mentioned diet. The third diet of pigs under test included 25 % nettle hay meal to replace the protein in concentrated feed. A mixture of micro- and macroelements was used as a mineral additive. The meal was given as dry form twice a day. Nettle hay meal was dried when nettle grass in the budding phase. Nettle hay was ground with a mill of 2 mm grid diameter. Long-term feeding with nettle hay meal in the amount between 12.5 % and 25 % of protein in the concentrated feed diet does not reduce the growth index of the pigs under test and does not increase the consumption of feed units, metabolism and protein per 1 kg of their growth compared to stock fed with concentrated feed rations. The growth indicator analysis demonstrates that the assessing stabable growth of piglets under test is higher than in the rest of groups under test. A similar tendency is observed in the growth tension index assessment. When growing the proportions of piglets' body structure change, it depends not only on changes in their live weight. So at 8 months of age the pigs that comsumped 12.5 and 25 % nettle hay meal had the highest linear growth rates compared to the other group under test. The results of hematological studies proved the replacement of concentrated fodder protein with nettle hay meal contributed to the increase in the erythrocyte amount, hemoglobin and total protein in the blood.

Key words: pigs, young stock, nettle, hay meal, concentrated feed, average daily, absolute, relative growth, mineral elements, feed consumption, formation intensity, stress index, hematological indicators.

Problem statement and analysis of recent research. Pigs are a kind of dangerous for people as they consumpt grain and its products. The grain on the food market is constantly increasing. Therefore, the researches on the maximum using of cheap non-grain feed for pigs is of great importance [6, 11, 14]. Scientists: P.S. Avramenko, I.G. Brushinin, V.G. Golubev, V.I. Yaremenko have made a significant contribution to the study of issues of feeding pigs with minimal grain consumption [1, 5, 7, 18]. A valuable non-cereal component in pig diets can be nettle, which takes the leading place among green fodder because of its nutritional qualities and beneficial effects on the body.

There are 10 types of nettles growing in Ukraine. It grows everywhere in darkened places or ravines, around houses, on the banks of reservoirs, on wastelands. Urticadioica, a perennial root plant with a four-sided hollow stem 50–150 cm high, densely covered with a kind stinging fur, has the greatest fodder value. The leaves of dicotyledonous nettle are egg-shaped, heart-shaped,

and coarsely toothed. Its leaves and shoots contain 140–300 mcg of carotene, 1000–2000 mcg of carotene, 1000–2000 mcg of vitamin C, 20–20 mcg of vitamin B2, 24–25 mcg of vitamin K per 1 kg of dry matter. Nettle significantly exceeded many other and wild plants in terms of content mineral substances. So, there is three times more iron and manganese and five times more copper and zinc in nettle than in alfalfa. In addition, it contains tannins, organic acids and a number of other biologically active substances. However, a restraining factor for pig feeding is the high rate of fiber and some biologically active substances [17]. Dried nettle is a good fodder and is eaten with appetite by every farm animal. If mowed before flowering and thoroughly dried, nettles turn into good hay, containing as much protein as alfalfa or clover. The plant accumulates iron, calcium, magnesium, zinc, iodine, selenium, cobalt, water and fat-soluble vitamins thanks to its medicinal properties [29]. Research by Nepali scientists has proved the beneficial effect of annual productivity in pig farming, grain crops are less and grow in excess, which would otherwise be lost throughout the hilly region of the country. In spite of the fact that there is no proves in gemativ and antiparasitic effects, the nettle obtains non-specific to the mammals. So the pigs under test appeared to be very healthy despite of the low energy diet and low dry matter content compared to other groups [16, 19, 20, 22]. Nettle is a good source of vitamins and minerals. It regulates the digestive system and stimulates appetite, it makes a positive effect on immune system and has some antibacterial activity. Nettle improves biochemical, hematological and immunological indicators of rabbits [19]. Nettle powder can replace the antibiotic in pig feed, as its amount is 3.0–7.5 % of the total weight of the feed [27].

Good results obtained when feeding rabbit with nettle hay meal provokes some experiments to test its effect on pigs [10, 16, 20]. The efficiency decrease in pig farming in many complexes has been caused by the low pig productivity, the slow growth of young stock and a death significant rate. This has been caused by poor-quality feed with insufficient content of vital vitamins, mineral elements, other biologically active substances and their absence. Mineral elements are the structural material of the animal body, they participate in the digestion of feed nutrients, absorption, synthesis, decay and excretion of metabolic products from the body. They create conditions for normal function of vitamins, enzymes, hormones, stabilize acid-alkaline balance and osmotic pressure [2, 4, 8, 15]. Grain feed satisfies only 50–85 % of mineral element need. Their lack is compensated by mineral additives, hay meal as part of compound feed, feed mixtures. The use of hay meal is one of the increasing productivity elements for pigs. Its composition includes more than 40 different micro-ingredients, namely: trace elements, vitamins, amino acids and other substances. Recently many countries there the pig farming is developed have been conducting research on revising and clarifying the rules for introducing hay meal out of legumes, cereals, and other types of plants (nettle). Their inpact as thesources of energy, protein, macro- and microelements, sorbents of toxins, substances that contribute to the removal of heavy metals from the body, and their therapeutic effect on diarrhea in pigs have not yet been fully studies [9, 12, 13, 19].

The lack of nutrients in pig's diet effects negative not only on their productivity, but on the process of maturation of cells responsible for immune reactions as well. Deficiency of protein, amino acids, vitamins, macro- and microelements in rations adversely affects the productivity and reproductive functions of pigs. Their sources are grain, animal feed, waste from various industries, hay meal [13, 21, 24]. Scientists [23, 25, 26, 28] believe that one of the reasons for the unsatisfactory state of pig farming is the lack of high-quality fodder, a deficiency in the rations of protein and biologically active substances, including vitamin and mineral supplements. This stimulates the search for additional feed additives.

The aim of the research is to analyse the effect of feeding different doses of nettle hay meal replacing concentrated feed on the growth and development of young pig stock in terms of live weight and external measurements, parameters for evaluating the patterns of growth of piglets, consumption of nutrients per 1 kg of experimental animals, hematological indicators.

Material and methods of research. The scientific and economic experiment has been conducted on of the Large White pigs. For the experiment, according to the principle of analogues, 54 piglets of 5–6 months of age were selected, one main and two groups under test (10 sows and 8 piglets in each group) were formed. The experiment lasted 146 days. During this period, piglets of the main group were kept on diets containing barley, wheat, pea and corn grits and sunflower meal. In the diet of the second group under test, hay mealcontained nettle, replacing 12.5 % of the protein of the above-mentioned feeds. The diet of the pigs of the third group included 25 % nettle hay meal protein instead of concentrated feed. A mixture of micro- and macroelements was used as a mineral supplement. Feed was given in the form of dry feed twice a day. Nettle hay meal was pre-

pared from dried nettle grass in the budding phase. Nettle hay was ground with a special mill of grid diameter of 2 mm.

Intensive growth and development of the pigs under test was calculated in absolute values of weight gain and linear indicators. For this, the average daily increase in live weight was determined according to the generally accepted formula.

The absolute increase in live weight was calculated according to the formula:

$$A = W_2 - W_1$$

A is the absolute increase in the live weight, kg;
W1, W2 - live weight, at the beginning and at the end of the period, kg.

Average daily growth was determined by the formula:

$$СП = \frac{A}{t}$$

SP is the average daily increase, g
t – period between two weighings, days.

To select the criteria for evaluating the patterns of growth of pigs in early ontogeny, the following indicators were determined:

– relative growth according to the formula:

$$ВП = \frac{(W_2 - W_1)}{W_1} \times 100$$

W1 is the live weight of animals at the beginning of the period;
W2 – live weight of animals at the end of the period.

– the intensity of the formation of animals (Δt) was determined by the formula:

$$\Delta t = \frac{W_6 - W_4}{0{,}5 \times (W_6 + W_4)} - \frac{W_8 - W_6}{0{,}5 + (W_8 + W_6)}$$

W4, W6, W8 are the live weight of pigs at 4, 6, and 8 months of age.

Indices of stress (In) and uniformity of growth according to V.P. Kovalenko's method:

$$In = \frac{At}{ВП} \times СП$$

where СП is the average daily increase, g
ВП – relative growth, %

$$Ip = \frac{1}{1 + \Delta t} \times СП$$

Hematological studies were carrieed out with 5 animals from each group. Blood from pigs under test was taken from the lateral branch of the auricular veins by puncturing it. The following blood parameters were studied: the number of erythrocytes according to the generally accepted method, by counting in the Goryaev chamber; hemoglobin content – according to the generally accepted method with the help of Sali'shemometer; the content of total protein in blood serum – by the refractometric method.

Calculation of feed costs per 1 kg of live weight gain (3k) in feed units according to the formula:

$$З_к = \frac{К_к}{П}$$

Зк – feed consumption per 1 kg of live weight gain, feed units;
$К_к$ – the amount of fodder fed during the accounting period, fodder units;
П – gross increase in live weight, kg.

Biometric processing of the results was carried out by generally accepted methods of variational statistics using the program MS Excel 2010

Results and discussion. Feeds that were available on the farm were included in the rations: barley, wheat, pea, corn grits, sunflower meal, nettle hay meal in accordance with the experiment scheme, and mineral supplements. The replacement of concentrated feed protein with nettle hay meal protein in the diets of the experimental groups was excluded. of them protein-rich feed: sunflower meal and pea grits, and also changed the ratio of other components.

The rations for the groups under test were calculated to obtain average daily gains of 450–600 g. During the main period of the experiment, the pigs of the first and second experiments used four doses of feed, composed, respectively, of live weight (40, 60, 80 and 100–120 kg).

The nettle hay meal in the diets of the pigs of the second experimental group, depending on their age and weight, was 0.120–0.240 kg. The share of nettle protein from the total amount of it in the diet was 12.5 %. From 0.240 to 0.410 kg of nettle hay meal (25 % protein) was added to the rations of the pigs of the third group. The introduction of nettle hay meal into the rations of pigs reduced the need for additional doses of mineral fertilizers, especially calcium and manganese.

For 1 kg of gain, pigs of the main group of the first spent 6.46 feed units, 4.72 dry matter, 69.2 MJ of exchangeable energy, 0.60 kg of digestible protein. The indicated parameters of the pigs of the groups under test differed little from the indicated parameters of the pigs of the control group (Table 1).

He–pigs of the main group increased their weight by 72.9 kg in 146 days, and pigs by 72.8 kg, their average daily weight gain was 499 and 497 g (Table 1). The introduction of 12.5 % nettle hay

meal protein into the diet of experimental pigs (the second research group) did not negatively affect their weight gain. The total weight gain of piglets was 72.1 kg, and gilts – 72.5 kg, the average daily weight gain was 493 and 496 grams, in parallel. When the amount of nettle hay meal in the rations of pigs (the third group) was increased to 25 % by protein, a decrease in growth indicators was not observed.

During the experiment, it was established that he-pigs and she-pigs had different growth rates depending on the period of the experiment (Table 2).

At the beginning of the experiment, at the age of 5 months, the animals of all groups had almost the same live weight, but at the age of 6 months he-pigs and she-pigs of the main group exceeded the counterparts of the main group by 1.3 kg according to this indicator (P>0.99). Subsequently, the process of equalizing the live weight of young stock was stated, and at the age of 9 months, the pigs of the 2nd group under test weighed 131.4 kg, which is 2.3 kg more (P>0.99) compared to the main group (129.1 kg) (Table 3).

Table 1 – **Nutrient Consumption per 1 kg of growth of the pigs under test**

Measures	Groups under test		
	main	1 tested group	2 tested group
Fodder unit	6,46	6,53	6,68
Dry matter, kg	4,72	4,81	5,14
Matabiloc energy, MJ	69,2	71,3	73,8
Protein, kg	0,78	0,79	0,82
Soddenprotein, kg	0,60	0,61	0,63

Table 2 – **Weight increase** $\overline{X} \pm S_{\overline{X}}$ (n=18)

Measures	Groups under test		
	main	1 tested group	2 tested group
he-pig, n=9			
Starting life weight, kg	57,7±0,84	57,8±0,93	57,7±0,81
Result life weight, kg	130,6±3,20	129,9±3,21	129,1±3,23
Body weight increase, kg	72,9±2,16	72,1±2,78	71,4±2,42
Daily avarege body weight increase, g	499±12,4	493±13,3	489±17,5
she-pig, n=9			
Starting life weight, kg	56,4±1,29	56,2±1,21	56,6±1,18
Result life weight, kg	129,0±4,84	128,7±4,42	130,1±7,03
Body weight increase, kg	72,6±3,13	72,5±3,13	73,5±2,92
Daily avarege body weight increase, g	497±24,7	496±21,4	503±17,3

Table 3 – **Life weight of he- and she- pigs,kg** $\overline{X} \pm S_{\overline{X}}$ (n=18)

Age (months)	Groupd under test		
	main	1 tested group	2 tested group
he-pigs			
5	57,7±0,64	57,8±0,73	57,7±0,71
6	69,9±0,73	72,2**±0,74	71,4±0,64
7	84,1±0,64	85,6±0,44	85,1±0,63
8	109,3±0,88	110,4±0,77	109,1±0,58
9	130,6±3,10	129,9±3,31	129,1±3,49
she-pigs			
5	56,4±1,39	56,2±1,31	56,6±1,28
6	71,2±2,13	72,5**±1,25	71,6±1,64
7	84,9±3,14	85,8±2,21	85,9±3,18
8	106,1±1,68	107,3±2,17	106,8±1,69
9	129,1±4,64	128,7±4,24	131,4**±6,05

Note: **(P<0,01).

The of growth pattern assessment of pigs based on average daily growth, relative growth, formation intensity, growth stress index, growth uniformity is presented in Table 4. The index of the formation of animals was greater in main group by 0.142 than for pigs of group 2 and by 0.088 in parallel with main group. The growth stress index of young stock in the main and 1–2 groups under test was: 1.018; 0.697; 0.499. The growth uniformity index of gilts for group 2 was 0.427, and the main group was 0.368. There was almost no difference in the growth of group 1 gilts (0.369) compared to the main group.

The index of the pigs' formation was greater in main group by 0.137 than in piglets of group 2 and by 0.089 in parallel of experimental group 1. The growth stress index of young stock in the main and 1–2 groups under test, respectively, was: 1.028; 0.699; 0.497. The growth index of piglets in group 2 was 0.423, and the main group was 0.367. There was almost no difference in the uniformity of growth of piglets of experimental group 1 (0.368) compared to the main group.

While growing the proportions of pigs' body structure change depending not only on changes in live weight. Characteristics of the growth and development of young animals based on linear body measurements are more complete and accurate. Linear growth is determined by measuring animals. In the process of rearing repair pigs with different doses of nettle feeding, some difference in changes in the linear diameters of the animals was established (Table 5).

It was proved 6 month old animals of groups 1 and 2 were characterized by higher indicators of body length. At this age, it was 111.6 and 111.4 cm in parallel. This is 1.9–1.7 cm more than that of the piglets of the main group. By breast girth 6 month old pigs of the main group prevailed over peers of the 2 other group by 11.4 cm (P>0.999). Some difference in height at the shoulder was established. According to these indicators, the animals of the main group were inferior to the analogues of the 1st experimental group by 0.9 cm and the 2nd by 1.3 cm. When 8–month old the piglets with 12.5 % and 25 % nettles hay meal had the highest indicators of linear growth, in comparison with the main group.

Productivity of pigs depends on the amount of total protein in blood serum: with an increase in the level of productivity, the amount of protein also increases. The hematological parameters of the pigs under test are shown in the Table 6.

The results of hematological studies have proved that replacing the protein of concentrated feeds with nettle hay meal (12.5 % and 25 % by protein) contributed to the increasing rate in the blood: the content of erythrocytes by 1.30 and 1.42 mg % (P>0.999) and the hemoglobin content, respectively, by 1.37 and 1.49 g % (P>0.999), total protein content by 0.25 and 0.47 g % (P>0.999).

Table 4 – **Indicators of evaluation of patterns of growth of piglets**

Measures	Groups under test		
	main	1 tested group	2 tested group
Avarige per day, g	497	496	503
Relative growth, %	129,4	129,1	132,4
Intensivity (Δt)	0,283	0,194	0,146
Growth power index (In)	1,028	0,699	0,497
Growth Constancy (Ip)	0,367	0,368	0,423

Table 5 – **Age-related changes in linear diameters of pigs under test**,см $X \pm S_x$ (n=9)

Group	Body length	Chest girth	Height at the shoulder
6 month old pigs			
Main	109,8±0,09	110,3±0,014***	59,9±0,07
1 group under test	111,7±0,06	112,1±0,08***	60,4±0,06
2 group under test	111,5±0,07	98,9±0,08***	60,3±0,05
8 month old pigs			
Main	117,9±0,06	119,4±0,07***	65,5±0,03
1 group under test	119,4±0,07	124,9±0,08***	66,4±0,06
2 group under test	118,3±0,08	121,8±0,07***	66,7±0,04

Note: ***P>0,999.

Table 6 – **Hematological rates of pigs under test** $X \pm S_x$(n=5)

Measures	Groups under test		
	main	1 tested group	2 tested group
Erythrocytes, mg %	4,05±0,03	5,35±0,009***	5.47±0,008***
Hemoglobin, г %	10,47±0,03	11,84±0,08***	11,96±0,06***
Notal protein, г %	10,58±0,04	10,93±0,03***	10,95±0,06***

Note:***P>0,999.

Wide use of nettle hay meal in pig diet is recommended by Ukrainian and foreign scientists [1, 5, 7, 18, 23, 27, 28]. Nettle is a fairly high-energy feed. The nutritional value of nettle herbage ranges from 0.18 to 0.22 k.o., and the digestible protein content is from 24 to 29 g per 1 kg and depends on the vegetation phase and dry matter content. In nettle hay meal, the concentration of the indicated indicators increases 3–4 times [17, 22, 26]. As a result of the conducted research, it is possible to speak with high reliability about the expediency of using nettle in feeding pigs as a valuable non-cereal component, which due to its nutritional qualities and favorable influence on the body occupies one of the first places among plants. age of nettle hay meal in a scientific and economic experiment that lasted 146 days, the live weight of animals at the beginning of the experiment was: 57.7–57.8 kg in boars and 56.2–56.6 in gilts. At the end of the research, the increase in the live weight of he-pigs was 130.6 kg in the main group and in the 2nd group under test was 129.9, where the level of protein replacement of concentrated feed with hay meal increased to 12.5 %, and in the 3rd group to 129.1 kg, where the level of protein replacement of concentrated feed with hay meal was 25 %. At the same time, the dose of mineral feeding was reduced to balance the diet. Live weight of pigs in the main group at the beginning of the research was 56.4 kg, at the end – 129.1 kg, and in the second group – 56.2 kg. After replacing protein concentrate feed with nettle protein, their live weight increased to 128.7 kg, and when replacing 25 % of protein in the 3rd group from 56.6 kg to 131.4 kg, which exceeded the results of the second group and the main group. At the same time, the consumption of nutrients was as follows: c.o.d. – 6.46 main group, 6.53 – 2 group and 6.68 – 3 group. Dry matter: 4.72 kg – main group, 4.81 kg – 2 group under test and 5.14 – 3 group. Protein 0.78 kg – main group, 0.79 – 2 group and 0.82 kg – 3 group. The following indicators were obtained for digestible protein: in the main group, the consumption was 0.60 kg, in the 2nd group – 0.61 kg, and in the 3rd group – 0.63 kg. Therefore, the introduction of nettle hay meal into the diets of repair pigs in the amount of 12.5 up to 25 % protein, replacing it with cereal protein, does not affect the indicators of feed payment and the consumption of basic nutrients. According to our data, the average daily gain of piglets of the main group was 6g less than that of the analogues of the second group and 1g more compared to animals the main group. The relative increase in young animals of the second group reached 132.4 %, and in the main and first groups: 129.4 and 129.1 %, respectively. The index of animal formation was greater in the sows of the main group than in the counterparts of the first and second groups under test. The uniformity of the growth of piglets of the main group was almost not different compared to the other groups. The characteristics of the growth and development of young stock according to the data of linear body diameters are more complete and accurate. In the process of raising pigs with different doses of nettle feeding, some difference in the linear measurements of the animals was established. We found that at the age of 6 months, the animals of the first and second experimental groups were characterized by higher body length indicators, and in terms of breast girth, at the specified age, the animals of the main group exceeded the peers of the second experimental group by 11.4 cm (P>0.999). A certain difference in height at the shoulders was established: according to this indicator, the animals of the main group were inferior to the analogues of the group 1 to 0.9 cm and the group 2 to 1.3 cm. By the end of 8 months, piglets that received 12.5 % and 25 % nettle hay meal by protein, had the highest linear growth rates compared to the control group. Thus, the obtained data testify to the positive effect of protein replacement of concentrated feeds with nettle protein on age-related changes in the exterior of pigs, hematological indicators and coincide with the results of research by Ukrainian and foreign scientists [11, 13, 15, 18, 19, 25, 27, 29].

Conclusion. Nettle hay can be a highly nutritious feed not only for poultry, but also for pigs. In terms of protein and essential amino acids in the dry matter, nettle is not worse to such widely used forages in pig feeding as leguminous meal and

sunflower meal, it is rich in minerals and vitamins. Long-term feeding of hay meal to pigs with nettles in the amount of 12.5 % and 25 % of the protein in the diet instead of concentrated feed does not reduce the intensity of their growth. Raising pigs on rations with nettle hay meal does not lead to an increase in the consumption of feed units, exchangeable energy and protein per 1 kg of their growth compared to animals kept on concentrated rations. The analysis of indicators of of the regular growth assessment of piglets shows that the index of formation of animals is higher amoung the young stock of the main group than in parallel of the experimental groups. A similar terndency is observed in the assessment of the growth tension index. During the growth of pigs, the proportions of their body structure change, which depend not only on the change in live weight, so at 8 month old pigs receiving 12.5 % and 25 % nettle hay meal had the highest linear growth rates compared to the main group. The results of hematological studies showed that the replacement of concentrated feed protein with nettle hay meal increased the erythrocytes, hemoglobin and total protein rates in the blood.

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Вплив згодовування сінного борошна кропиви на ріст і розвиток ремонтного молодняку свиней

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Досліджено вплив згодовування різних доз сінного борошна кропиви при заміні ним концентрованих кормів на ріст та розвиток молодняку свиней за живою масою та екстер'єрними промірами, показниками оцінки закономірностей росту свинок, витратами поживних речовин на 1кг піддослідних тварин, гематологічними показниками. Контрольна група свиней у зрівняльний і основний періоди досліду отримувала основний раціон (ОР: ячмінну, пшеничну, горохову та кукурудзяну дерть і соняшниковий шрот). До складу раціону другої дослідної групи вводили сінне борошно кропиви шляхом заміни 12,5 % протеїну зазначених вище кормів. До раціону піддослідних свиней третьої (дослідної) групи включали 25 % за протеїном сінного борошна кропиви замість концентрованих кормів. Як мінеральну добавку використовували суміш мікро-і макроелементів. Корми задавалися у вигляді сухого корму два рази на добу. Сінне борошно кропиви готували із висушеної трави кропиви, скошеної у фазі бутонізації. Сіно із кропиви подрібнювали за допомогою спеціального млина з діаметром решіток 2 мм. Тривале згодовування свиням сінного борошна кропиви в кількості 12,5 та 25 % протеїну раціону замість концентрованих кормів не знижує інтенсивності їх росту, не призводить до підвищення витрат кормових одиниць, обмінної енергії та протеїну на 1 кг їх приросту порівняно з тваринами, що утримувались на концентрованих раціонах. Аналіз показників закономірності росту свинок свідчить, що індекс інтенсивності формування тварин є вищим у молодняку контрольної групи, ніж у аналогів дослідних груп. Аналогічна тенденція спостерігається за оцінкою індексу напруги росту. У процесі росту свиней змінюються пропорції будови їх тіла, які залежать не тільки від зміни живої маси. Так, у 8-місячному віці свинки, що отримували 12,5 та 25 % сінного борошна кропиви мали найвищі показники лінійного росту у порівнянні з контрольною групою. Результати гематологічних досліджень показали, що заміна протеїну концентрованих кормів сінним борошном кропиви сприяла збільшенню в крові вмісту еритроцитів, гемоглобіну та загального білка.

Ключові слова: свині, молодняк, кропива, сінне борошно, концентровані корми, середньодобовий, абсолютний, відносний приріст, мінеральні елементи, витрати кормів, інтенсивність формування, індекс напруги, гематологічні показники.