ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. XXVII (2) SECTIO EE 2009

[1]Department of Biochemistry and Toxicology, [2]Institute of Animal Nutrition, University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin,
e-mail: annaczech@poczt.fm

ANNA CZECH[1], EDYTA KOWALCZUK[2], EUGENIUSZ R. GRELA[2]

The effect of a herbal extract used in pig fattening on the animals' performance and blood components

Wpływ dodatku ekstraktu ziołowego w żywieniu rosnących świń na efekty produkcyjne i składniki krwi

Summary. The aim of the study was to determine the effect of an addition of a herbal extract (Prodol B) from garlic bulbs, common liquorice roots and tillers, common thyme herb and caraway fruits in pig fattening on the animals' performance, some morphological parameters (Ht, Hb, Ht, RBC, WBC, leucogram) and on the activity of some blood enzymes (AST, ALT, AP, LDH). The animals were divided in 3 groups (3 groups × 40 piglets), kept in pens, 10 animals each. Group I (control) animals were fed with standard mixtures (Starter, Grower, Finisher) without any additives, whereas group II and III – the same mixtures, but supplemented with AGP (avilamycin) or a herbal extract (0.8 g kg^{-1} feed), respectively. Feed intake (daily) and body weight (4 times) were controlled. Blood samples were collected 3 times (at about 25, 60 and 90 kg body weight). The average daily gains (798 g with Prodol B vs. 812 g with AGP and 748 in the negative control group), feed conversion ratio (2.66 vs. 2.63 and 2.88, respectively) and blood parameters proved that this herbal preparation may constitute a valuable alternative for AGP, feed additive to the balanced feed mixtures with regard to basic nutritive components, minerals and vitamins in the feeding of growing pigs.

Key words: pigs, extract of herbs, performance, blood

INTRODUCTION

The ban on the use of antibiotic growth promoters (AGP) in feeding farm animals including pigs, introduced on 1st January 2006, contributed to research aimed at finding natural feed additives which could replace them (probiotics, prebiotics, feed enzymes, organic acids, herbs). Among the group of AGP substitutes, an increasing attention is paid to herbs [Wenk 2000, Grela and Semeniuk 2006]. Herbs may be used as preparations containing a herbal mixture or as individual herbs, though their mixtures reveal

higher effectiveness. They may be also added to feeds in the form of herbal extracts [Wenk 2000, Hanczakowska and Świątkiewicz 2005, Grela *et al*. 2007]. They have multiple effects, e.g. anti-bacterial, anti-viral, anti-inflammatory, anti-oxidant; they also stimulate appetite, regulate digestion and metabolism, have anti-diarrheal effect and stimulate hormonal and immune systems [Kołacz *et al*. 1997, Grela and Semeniuk 2006]. Thus the most vital aim of using such additives in pig growing is stimulating the animals' growth and preventing diseases of the digestive tract [Lin *et al*. 2000]. Herbs used in fattener growing are supposed to boost performance and the quality of meat. The results of studies suggest that herbs used as a supplement in feeds for growing-finishing pigs have a positive effect on the slaughter values of carcass and improve the taste, flavor, tenderness and succulence of the meat produced by those animals. Better feed conversion and higher weight gains were noted, as well [Grela *et al*. 1998, Cullen *et al*. 2005, Han-czakowska and Świątkiewicz 2005]. There are few studies available concerning the influence of herbal extracts on hematological components and the activity of certain blood enzymes.

The aim of the present study was to determine the influence of a herbal extract including garlic bulbs (*Allium sativum)*, common liquorice roots and tillers (*Glycyrrhiza glabra* L.), common thyme herb (*Thymus vulgaris* L.) and caraway fruits (*Carum cavi* L.) in pig fattening on the animals' performance, the morphological picture of blood and the activity of some blood enzymes in blood plasma.

MATERIAL AND METHODS

The experiment was performed using 120 piglets, crosses of pbz × (Duroc × Hampshire), divided into 3 equal groups. The animals were kept in groups in pens (10 animals each. Group I animals made a negative control group (NC) and were fed standard Starter mixtures (15–30 kg), and later Grower (30–65 kg) and Finisher (final stage of fattening) mixtures with a standard premix but without any addition of feed antibiotic. The animals in group II (positive control – AGP) received the same mixtures as group I, respectively, yet the premix contained an antibiotic growth promoter (AGP – Avilamycine). Group III (Herbs) was administered feeds like in group I, yet with an addition of a herbal preparation, Prodol B, amounting to 800 g ton^{-1} of the feed. The herbal preparation contained an extract from garlic bulbs (*Allium sativum)*, common liquorice roots and tillers (*Glycyrrhiza glabra* L.), common thyme herb (*Thymus vulgaris* L.) and caraway fruits (*Carum cavi* L.). The herbal preparation was combined with the premix and next added to the remaining components of the mixture.

All piglets in pens were individually ear-marked with plastic ear-rings. The hygienic conditions, i.e. temperature, relative humidity and cooling were identical for the control and experimental groups. Water was available in automatic drinking troughs. Feeds were analyzed in order to determine their content of basic nutrients and lysine and methionine, following the procedures recommended in AOAC [2000]. The animals were weighed at the beginning of the analyses, at every change in their diet and immediately before slaughter. During the experiment feed consumption was noted for animals in individual pens and the pigs' health condition was observed.

Blood samples were taken three times (at the end of the piglet stage, at 25 kg, and then at their reaching 60 kg and 90 kg body mass) and hematological indices were marked (hematocrit – Ht, hemoglobin – Hb, erythrocyte count – RBC, leukocytes – WBC, blood picture: neitrocytes – NEU, lymphocytes – LIM, MID = eosinocytes + basocytes + monocytes) on Abakus Vet apparatus. Blood plasma was analyzed to mark alanine (ALT) and asparaginian (AST) aminotransferase activities, alkaline phosphatase (AP), and also lactate dehydrogenase (LDH) with the use of monotests developed by Cormay company. After reaching the mass of 105 ± 2 kg the animals were slaughtered and subject to abridged slaughter analysis according to SKURTCh.

The obtained numerical data were subject to variance analysis (ANOVA) and mean values and standard deviations for individual groups were calculated, whereas the significance of the differences between mean values was determined with the use of t-Student test.

RESULTS AND DISCUSSION

Feed mixtures of Starter, Grower and Finisher types used in feeding the animals in control groups (NC and AGP) contained 181.3, 169.8 or 150.4 g of total protein per 1 kg, respectively to the fattening period, and 11.2, 8.1 or 7.4 g of lysine (Tab. 1). These values are in compliance with the recommendations included in Feeding Standards for Pigs [Normy... 1993]. The addition of the herbal extract did not affect the share of these elements in the mixtures for group III.

Performance indices referring to daily gains, feed conversion and selected slaughter traits are presented in Table 2. Mean weight gains in group I (NC) were adequate, regarding the type of nutrition with no growth promoters, and they amounted to 748 g daily on the average during the whole fattening period. Growing-finishing pigs fed a supplement of a herbal preparation called „Prodol B" (Group III – Herbs) reached significantly higher ($p \leq 0.05$) mean weight gains in the whole fattening period (798 g day^{-1}). They were similar to the weight gains in group II (812 g day^{-1}) and significantly higher than in group I. The best results were also observed in group III, concerning carcass meatiness (53.5%), and especially the loin eye (Tab. 2). This may suggest a positive influence of active substances present in the herbs on the metabolism in the pigs, their improved digestive processes and nutrient metabolism and, as a consequence, higher performance indices [Grela *et al*. 1998, Lin *et al*. 2000, Cullen *et al*. 2005]. The effects of using the herbal preparation, „Prodiol B", were comparable with those resulting from using AGP (Avilamycine). The highest share of fat tissue was noted in group I (NC) and group II with the AGP supplement. The consumption of feed during the whole fattening period was at the level of 2.63–2.88 kg, with a clearly lowering tendency in group III (Herbs), which suggest a better conversion of nutrients provided in the feeds with an addition of biologically active herbs [Wenk 2000, Grela *et al*. 2003, 2007]. The obtained results confirmed the assumption that an adequately composed set of herbs in the form of an extract may be added to fatteners' diets, replacing commonly used antibiotic growth promoters, since the pigs' growth rate and their slaughter value did not differ from the parameters observed in this respect in conventional fattening methods. The beneficial effects of herbs on production effects were also reported by other authors [Grela *et al*.

1998, Lin *et al*. 2000, Cullen *et al*. 2005, Hanczakowska and Świątkiewicz 2005, Grela *et. al.* 2007]. Discrepancies in the results of individual studies often result from differences in the quality of herbal materials, selection of particular herbs and forms of their administration (extracts, oils, dried herbs).

Table 1. Composition (%) and nutritive value of basic diets for growing-finishing pigs
Tabela 1. Skład recepturowy (%) i wartość pokarmowa standardowych mieszanek dla tuczników

Components, % Składniki, %	Mixture type Rodzaj mieszanki		
	Starter	Grower	Finisher
Barley ground Śruta jęczmienna	27.3	39.1	52.4
Barley and oat ground Śruta jęczmienna z owsianą	-	10.0	20.0
Wheat ground Śruta pszenna	45.0	30.0	10.0
Soya bean meal Poekstrakcyjna śruta sojowa	20.0	17.0	6.0
Rapeseed meal Poekstrakcyjna śruta rzepakowa	-	-	8.0
Fish meal Mączka rybna	3.0	-	-
Lysine Lizyna	0.2	0.1	0.1
Soya oil Olej sojowy	1.0	0.5	0.5
Trace mineral-vitamin premix Premiks mineralno-witaminowy	1.0	1.0	1.0
Mineral feed (ground chalk, salt) Pasze mineralne (kreda, sól)	2.5	2.3	2.0
Total Razem	100.0	100.0	100.0
Content in 1 kg of mixture: 1 kg mieszanki zawiera:			
Metabolizable energy, MJ Energia metaboliczna, MJ	12.89	12.67	12.53
Dry matter, % Sucha masa, %	89.69	89.49	89.38
Crude ash, g Popiół surowy, g	59.1	56.5	49.2
Crude protein, g Białko ogólne, g	181.5	169.4	150.3
Ether extract, g Ekstrakt eterowy, g	36.7	31.1	28.6
Crude fibre, g Włókno surowe, g	3.91	4.31	5.04
Total lysine, g Lizyna ogólna, g	11.2	8.1	7.4

Table 2. Performance and some carcass traits of growing-finishing pigs
Tabela 2. Wybrane wskaźniki produkcyjne rosnących świń

Item Wskaźnik	Feeding groups Grupy żywieniowe		
	I – NC I – KN	II – AGP II – ASW	III – Herbs III – Zioła
Daily gains, g Przyrosty dzienne, g	$748^{a} \pm 43$	$812^{b} \pm 44$	$798^{b} \pm 45$
FCR, kg kg^{-1} Zużycie paszy, kg kg^{-1}	$2.88^{b} \pm 0.13$	$2.63^{a} \pm 0.12$	$2.66^{a} \pm 0.11$
BW at slaughter, kg Masa przy uboju, kg	105.1 ± 2.2	105.4 ± 2.3	105.5 ± 2.1
Meaty, % Mięsność, %	51.8 ± 1.7	53.1 ± 1.8	53.4 ± 1.8
Eye area, cm^2 Oko polędwicy, cm^2	$42.6^{a} \pm 4.2$	$46.5^{b} \pm 4.4$	$47.2^{b} \pm 4.1$
Backfat thickness, mm Grubość słoniny, mm	26.9 ± 3.1	26.3 ± 3.3	24.5 ± 2.8

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$
a, b – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

The values of hematological indices (Ht, Hb, RBC, WBC, LIM, NEU, MID) in fatteners' blood at the body weight of 25, 60 and 90 kg are presented in Table 3. The values of pigs' hematological indices were within reference ranges [Friendship and Henry 1996, Winnicka 2004] in all the experimental groups. Fatteners fed a mixture with a supplement of AGP (group II) and the herbal mixture (group III) during the whole fattening period were characterized by a significantly higher value of red-blood-cell system indices (Ht, Hb, RBC), especially in the initial period of fattening (until gaining the body mass of 60 kg). This may suggest a better health condition of the animals receiving the herbal extract and also indicates proper erythropoesis [Friendship and Henry 1996]. Similar results were recorded by Grela *et al*. [2007] in their studies on growing-finishing pigs.

The lowest WBC value during the whole fattening period was observed in the fatteners from group II (AGP) and also from group III (Herbs). An increase in the number of leukocytes (WBC) in blood may suggest the presence of inflammation in the organism, so the results prove that both the addition of a herbal extract and a supplement of Avilamycine contributed to decreasing the number of WBC and thus reaching good immunity. Leukocytes make a heterogeneous group of cells comprising granulocytes, eosinocytes, basocytes and monocytes. Neutrophilic granulocytes are phagocytes and they live on and digest undesirable cells (mainly bacteria). No significant changes were noted regarding the content of these cells, depending on the supplement used in the diets during the whole fattening period. A slightly higher amount of lymphocytes was observed in the fatteners from group II (AGP) and group III (Herbs), which confirmed the animals' high immunity. The results concerning the indices of red- and white-blood- cell systems suggest the beneficial effect of herbs on animals' health [Kołacz *et al*. 1997, Lin *et al*. 2000, Grela *et al*. 2001, 2003, 2007].

Table 3. Hematological indices in blood of growing-finishing pig at 3 different body weight
Tabela 3. Wskaźniki hematologiczne krwi rosnących świń w trzech różnych okresach

Item Wskaźnik	Body weight, kg Masa ciała, kg	Feeding groups Grupy żywieniowe		
		I – NC I – KN	II – AGP II – ASW	III – Herbs III – Zioła
H t $l\ l^{-1}$	25	$0.33^{a} \pm 0.03$	$0.39^{b} \pm 0.02$	$0.38^{b} \pm 0.01$
	60	$0.23^{a} \pm 0.02$	$0.31^{b} \pm 0.03$	$0.25^{a} \pm 0.03$
	90	0.37 ± 0.02	0.37 ± 0.03	0.38 ± 0.02
H b $g\ l^{-1}$	25	$97.33^{a} \pm 5.35$	$107.3^{b} \pm 6.09$	$104.7^{ab} \pm 7.74$
	60	$74.33^{a} \pm 9.87$	$102.7^{b} \pm 12.48$	$84.17^{a} \pm 9.93$
	90	126.0 ± 10.92	122.5 ± 8.78	128.00 ± 4.94
R B C $10^{12}\ l^{-1}$	25	$6.03^{a} \pm 0.67$	$7.53^{b} \pm 0.46$	$6.70^{ab} \pm 0.59$
	60	$6.05^{a} \pm 0.54$	$7.03^{b} \pm 0.79$	$6.97^{b} \pm 0.34$
	90	$7.49^{a} \pm 0.37$	$8.86^{b} \pm 0.50$	$7.41^{a} \pm 0.52$
WBC $10^{9}\ l^{-1}$	25	$22.99^{a} \pm 3.00$	$16.23^{b} \pm 2.51$	$16.94^{b} \pm 3.14$
	60	$19.01^{a} \pm 2.17$	$17.44^{b} \pm 5.32$	$16.46^{b} \pm 2.69$
	90	$21.20^{a} \pm 2.72$	$16.09^{b} \pm 2.33$	$17.04^{b} \pm 1.41$
Leucogram, % Leukogram, %				
NEU	25	38.75 ± 6.96	46.67 ± 4.97	38.40 ± 5.54
	60	45.40 ± 4.39	41.75 ± 7.10	48.13 ± 4.83
	90	42.53 ± 7.96	36.70 ± 7.68	32.53 ± 8.88
LIM	25	55.97 ± 6.91	50.02 ± 5.10	57.17 ± 5.08
	60	52.02 ± 4.44	55.92 ± 6.21	49.80 ± 5.11
	90	52.40 ± 7.52	59.37 ± 6.73	63.27 ± 7.25
MID	25	5.28 ± 0.89	3.32 ± 1.82	4.43 ± 1.17
	60	2.58 ± 1.61	2.33 ± 1.48	2.07 ± 1.10
	90	5.07 ± 1.35	3.95 ± 2.56	4.20 ± 2.04

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$
a, b – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

Blood plasma of the growing pigs was also used to determine the activity of metabolic profile enzymes (AST, ALT, LDH and AP). The results obtained in the individual periods of the analyses and in all the studied groups were within reference values [Friendship and Henry 1996, Winnicka 2004], (Tab. 4). The activity of asparaginian aminotransferase (AST) during all the fattening periods was significantly higher ($p \leq 0,05$) in the group including the animals fed the additive of the antibiotic growth promoter (II) in comparison with group III (Herbs). Also in the animals in group II the activity of alanine transferase (ALT) was significantly higher, but in comparison with group I (NC). The animals with body mass of 90 kg in the group administered the herbal extract (III) revealed a similar activity of this enzyme (ALT), compared to the fatteners in group II.

Table 4. Activity of some enzymes (U l^{-1}) in blood serum of growing-finishing pig at 3 different body weight

Tabela 4. Aktywności wybranych enzymów (U · l^{-1}) w osoczu krwi świń w trzech różnych okresach tuczu

Enzymes Enzymy	Body weight, kg Masa ciała, kg	Feeding groups Grupy żywieniowe		
		I – NC I – KN	II – AGP II – ASW	III – Herbs III – Zioła
AST	25	$27.60^{b} \pm 4.97$	$35.20^{a} \pm 4.63$	$31.19^{ab} \pm 2.50$
	60	$38.20^{a} \pm 5.00$	$41.32^{a} \pm 5.93$	$31.42^{b} \pm 4.93$
	90	$31.11^{ab} \pm 5.19$	$35.29^{a} \pm 2.86$	$29.19^{b} \pm 4.34$
ALT	25	$44.88^{b} \pm 5.63$	$64.59^{a} \pm 4.56$	$42.86^{b} \pm 4.14$
	60	$29.00^{b} \pm 2.94$	$36.02^{a} \pm 3.53$	$34.21^{ab} \pm 3.47$
	90	$26.99^{b} \pm 3.70$	$33.37^{a} \pm 4.46$	$36.28^{a} \pm 2.38$
AP	25	$237.9^{b} \pm 20.8$	$270.3^{a} \pm 28.2$	$240.5^{b} \pm 23.51$
	60	$176.3^{b} \pm 8.13$	$194.8^{a} \pm 15.5$	$199.9^{a} \pm 18.39$
	90	$157.3^{b} \pm 9.83$	$189.9^{a} \pm 18.18$	$194.6^{a} \pm 19.89$
LDH	25	$702.3^{a} \pm 21.42$	$684.9^{a} \pm 36.48$	$532.3^{b} \pm 47.49$
	60	$638.9^{a} \pm 42.9$	$674.0^{a} \pm 26.9$	$599.5^{b} \pm 18.81$
	90	$798.2^{a} \pm 16.12$	$683.4^{b} \pm 27.16$	$675.8^{b} \pm 32.32$

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$

a, b – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

Physiologically, an increase in the activity of alkaline phosphatase (AP) occurs, among others, during the period of intensive bone growth, which was confirmed by the obtained results. The animals with the body mass of ca. 25 kg revealed such higher activity of AP, compared with its level in the remaining periods of fattening. In that period, similarly like in case of aminotransferases, the activity of this enzyme in the group fed a supplement of AGP was significantly higher in relation to group I and group III. In the remaining periods of fattening (60 kg and 90 kg body weight) the activity of AP in groups II and III was on a similar level, yet it was significantly higher ($p \leq 0.05$) when compared with the results observed in the control group (I). Slightly different results were recorded while analysing the activity of lactate dehydrogenase (Tab. 4). Similarly to the situation with aminotransferases and alkaline phosphatase, significantly higher activity of this particular enzyme was noted in the animals in group II, yet it was similar to the results obtained in the control group (NC) and significantly higher than the results recorded in animals receiving an addition of herbs (III). The observed changes in the activity of all the analyzed enzymes may suggest a lack of disorders in the metabolic processes in the studied animals. However, increased activity of the analyzed enzymes in the liver profile in the animals fed a supplement of feed antibiotic may result from liver overburden. Among the works available no studies were found discussing this issue.

CONCLUSION

The obtained performance and blood indices suggest a possibility of using a herbal preparation containing garlic bulbs, common liquorice roots and tillers, common thyme herb and caraway fruits, administered at the amount of 0.8 g kg^{-1} of the mixture as a replacement for the antibiotic growth promoter. Using the herbal extract results in high performance and a good metabolic profile of blood on the level which is comparable with AGP applied so far.

REFERENCES

AOAC, 2000. Official Methods of Analysis. International, 17th ed., AOAC Inter., Gaithersburg, MD, USA.

Cullen S.P., Monahan F.J., Callan J.J., O'Doherty J.V., 2005. The effect of dietary garlic and rosemary on grower-finisher pig performance and sensory characteristics of pork. Irish J. Agric. Food Res., 44(1), 57-67.

Friendship R.M., Henry S.C., 1996. Cardiovascular system, haematology and clinical chemistry. [In:] Leman A.D., Straw B.E., Mengeling W.L. (eds.), Diseases of swine. Iowa State Univ. Press, USA, 3-11.

Grela E.R., Czech A., Baranowska M., 2001. Efektywność dodatku ziół w odchowie prosiąt. Annales UMCS, sec. EEE, Horticultura 9, 249-254.

Grela E.R., Czech A., Krukowski H., 2003. Wpływ ziół na wzrost i składniki krwi prosiąt. Med. Wet., 59, 5, 410 – 412.

Grela E.R., Gruszczyk M., Czech A., 2007. Effectiveness of herbs mixture in growing-finishing pig diets. Herba Pol., 53, 3, 343-349.

Grela E.R., Krusiński R., Matras J., 1998. Efficacy of diets with antibiotic and herb mixture additives in feeding of growing-finishing pigs. J. Anim. Feed Sci., 7, 171-175.

Grela E.R., Semeniuk V., 2006. Konsekwencje wycofania antybiotykowych stymulatorów wzrostu z żywienia zwierząt. Med. Wet., 62, 5, 502-507.

Hanczakowska E., Świątkiewicz M., 2005. Gallic acid or sage extract supplement in feed mixtures for finishing pigs. J. Anim. Feed Sci., 14, Suppl. 1, 353–356.

Kołacz B., Bodak E., Świtała M., Gajewczyk P., 1997. Herb as agents affecting the immunological status and growth of piglets weaned body weight deficiency. J. Anim. Feed Sci., 6, 269-279.

Lin B., Qiu I.T., Huang C.H., Li G.P., Huang Y.F., 2000. Effect of Chinese medicinal herbs on blood biochemical parameters of piglets early weaning diarrhoea. Fujian J. Agric. Sci., 15, 37-40.

Normy żywienia świń, 1993. Inst. Fizjologii i Żywienia Zwierząt im. Jana Kielanowskiego, PAN, Omnitech Press, Warszawa.

Wenk C., 2000. Herbs, spices and botanicals: „Old fashioned" or the new feed additives for tomorrow's feed formulations? Concept for their successful use. [In:] Lyons T.P., Jacques K.A. (eds.), Biotechnology in the Feed Industry. Proceedings of Alltech's 16th Annual Symposium. Nottingham Univ. Press, 79-96.

Winnicka A., 2004. Wartości referencyjne podstawowych badań laboratoryjnych w weterynarii. Wyd. SGGW, Warszawa.

Streszczenie. Celem badań było określenie wpływu ekstraktu ziołowego (Prodol B) zawierającego wodno-alkoholowy wyciąg z cebulek czosnku, korzeni i rozłogów lukrecji gładkiej, ziela tymianku pospolitego oraz owoców kminku zwyczajnego w żywieniu tuczników na ich efekty produkcyjne, a także wskaźniki hematologiczne (Ht, Hb, Ht, RBC, WBC, leukogram) oraz aktywność wybranych enzymów (AST, ALT, AP, LDH) w osoczu krwi. Zwierzęta podzielone na 3 grupy utrzymywane były w kojcach, po 10 sztuk w każdym. Grupa I (kontrola) otrzymywała standardową mieszankę pełnoporcjową bez żadnych dodatków paszowych, a zwierzęta z grupy II i III – otrzymywały tę samą mieszankę, ale z udziałem antybiotyku paszowego lub ekstraktu ziołowego (0,8 g kg^{-1} paszy). Notowano dzienne spożycie paszy i masę ciała (4-krotnie). Krew pobierano trzykrotnie (przy masie ciała około 25, 60 i 90 kg). Średnie przyrosty dzienne na poziomie 798 g w grupie III (Zioła) oraz 812 g w grupie II (ASW) wobec 748 g w grupie kontrolnej (KN), zużycie paszy (odpowiednio 2,66, 2,63 i 2,88 kg kg^{-1} przyrostu), a także wybrane wskaźniki krwi wskazują, że dodatek preparatu ziołowego może stanowić cenny, alternatywny do antybiotykowych stymulatorów wzrostu, dodatek do mieszanek pełnoporcjowych w żywieniu rosnących świń.

Słowa kluczowe: świnie, zioła, efekty produkcyjne, krew