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THE EFFECT OF ACTIVE PLANT SUBSTANCES SUPPLEMENTATION ON FATTENING AND SLAUGHTER PERFORMANCE AND BLOOD SERUM BIOCHEMICAL PARAMETERS IN PIGS

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Abstract. The study was carried out on 70 pigs divided into two groups: control and experimental (APS), the latter receiving an addition of active plant substances: cinnamaldehyde, carvacrol and capsaicin in the amount of 80 mg per 1 kg feed. During the experiment, fattening and slaughter performance and blood serum biochemical indices, including total antioxidant status (TAS), were evaluated. The application of active plant substances during the fattening period did not have any effect on the improvement of fattening performance and carcass slaughter value. However, a statistically significant effect of this additive on lipid metabolism was observed, which is indicated by a decrease in the concentration of LDL fraction ($P \leq 0.05$) and an increase in that of HDL fraction ($P \leq 0.01$). Capsaicin, cinnamaldehyde and carvacrol also induced an increase in the protein concentration ($P \leq 0.01$) and total antioxidant status ($P \leq 0.05$) in the blood serum of fatteners.

Key words: antioxidant status, fattening, pigs, plant extracts, serum

INTRODUCTION

Due to the withdrawal of antibiotic growth promoters, an interest in the application of herbs in farm animal nutrition has increased. Return to these additives is associated with the active substances contained in them which affect animal production results. Research works being carried out with the application of herbs

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in pig nutrition have shown their favourable effect in the fattening and an improvement of slaughter value as well as carcass quality [Cullen et al. 2005]. Herbs can be applied in the form of dried material or extracts containing active substances. The application of preparations being composed of herbal extracts allows reduction of feed ration and specification of their effects [Hashemi and Davoodi 2011]. The application of plant extracts may affect not only appetite improvement and nutrient utilisation but also may influence the physiological processes and be reflected in the improvement of health state [Frankic et al. 2010].

Carvacrol, coming from oregano, is characterised by strong bacteriostatic and antioxidant action [Avila-Sosa et al. 2010]. Capsaicin (chilli pepper) has an effect on the increase of secretion of digestive enzymes, which improve digestion, and on better absorption of nutrients [Gonzalez et al. 1998], as well as has antioxidant properties [Kogure et al. 2002]. On the other hand, cinnamaldehyde (cinnamon) shows antibacterial, immunostimulatory and antioxidant properties [Chao et al. 2008]. Manzanilla et al. [2004] demonstrated the positive impact of these substances on the development of the flora of the digestive system. However, the mechanism of synergistic action of these active substances is not fully known.

In view of this, a study has been carried out aiming at determination of the effect of plant preparation containing carvacrol, capsaicin and cinnamaldehyde on the fattening efficiency, carcass slaughter value and selected biochemical indices in the blood serum, including total antioxidant status (TAS).

MATERIAL AND METHODS

The study was carried out on 70 pigs hybrids from Polish Large White $\times$ Polish Landrace sows sired by Pietrain $\times$ Duroc and Duroc $\times$ Pietrain boars. Animals were divided into two groups: control (K) and experimental (APS), 35 pigs each. They were selected to groups by the method of analogues with respect to sex (half gilts, half barrows), body weight and breed of pigs. Animals of both groups were fed an identical complete feed (Table 1), differentiated by applied additive for the experimental group (APS), which received an addition of active plant substances (APS) – cinnamaldehyde from cinnamon, carvacrol from oregano and capsaicin from chilli pepper in the amount of 80 mg $\cdot$ 1 kg^{-1} feed mixture. Animals of the studied groups were kept in separate group pens. Pigs were fed ad libitum, with a permanent access to water.

Nutritional part of the experiment was conducted at the body weight from 35 $\pm$1.2 kg to 100 $\pm$2.6 kg. During the experiment, the body weight was determined at the beginning and at the end of fattening, as well as daily gains and feed conversion ratio. After slaughter, meatiness, loin eye area and backfat thickness

Table 1. Composition and nutritive value of basal diets[1]

Tabela 1. Skład i wartość pokarmowa mieszanek[1]

Ingredient – Składnik	g · kg^{-1}
Barley – Jęczmień	191
Wheat – Pszenica	320
Rye – Żyto	220
Maize – Kukurydza	40
Wheat bran – Otręby pszenne	30
Soybean meal (CP 47%) – Mączka sojowa	165
Rapeseed oil – Olej rzepakowy	5
Premix[2] – Premiks[2]	26
Acidificator – Zakwaszacz	3
Nutrients – Składniki odżywcze	
Metabolizable energy (MJ/kg) – Energia metaboliczna	13.1
Crude protein – Białko surowe	169.0
Crude fibre – Włókno surowe	34.0
Lysine – Lizyna	9.1
Methionine + cystine – Metionina + cystyna	6.2
Threonine – Treonina	6.4
Tryptophan – Tryptofan	2.0
Calcium – Wapń	6.5
Phosphorus – Fosfor	4.7

[1] Experimental diet was supplemented with 80 mg XTRACT™ 6930 (Pancosma, Switzerland) per 1 kg diet.
[1] Mieszanka doświadczalna była uzupełniona dodatkiem 80 mg XTRACT™ 6930 (Pancosma, Switzerland) do 1 kg mieszanki.
[2] Provides the following per kg of diet: vitamin A – 10 400 IU; vitamin D_3 – 1720 IU; vitamin E – 80 mg; vitamin K_3 – 2 mg; vitamin B_2 – 5 mg; vitamin B_6 – 4 mg; vitamin B_{12} –10 mg; biotin – 93 mg; folic acid – 0.8 mg; choline chloride – 260 mg; pantothenic acid – 13 mg; Mn – 78 mg; Zn – 78 mg; Cu – 150 mg; I – 1.5 mg; Se – 0.3 mg; Fe – 75 mg; Mg – 0.3 g; Ca – 4.6 g; P – 0.8 g; lysine –1.8 g; methionine – 0.3 g.
[2] Wprowadza do 1 kg mieszanki: witamina A – 10 400 IU; witamina D_3 – 1720 IU; witamina E – 80 mg; witamina K_3 – 2 mg; witamina B_2 – 5 mg; witamina B_6 – 4 mg; witamina B_{12} – 10 mg; biotyna 93 mg; kwas foliowy – 0,8 mg; chlorek choliny – 260 mg; kwas pantotenowy – 13 mg; Mn – 78 mg; Zn – 78 mg; Cu – 150 mg; I – 1,5 mg; Se – 0,3 mg; Fe – 75 mg; Mg – 0,3 g; Ca – 4,6 g; P – 0,8 g; lizyna –1,8 g; metionina – 0,3 g.

were determined on the left-carcass between the 3rd and the 4th ribs, 6 cm from the halving line, by means of a needle-optical CGM (Sydel, France) apparatus.

Prior to slaughter, blood samples was collected from porkers from the jugular vein to obtain serum on the welfare of animals. After blood centrifugation, serum was frozen at –20°C. In the thawed serum, the following biochemical indices were determined: total protein, glucose, total cholesterol, HDL fraction, LDL fraction, triglycerides, and TAS (Total Antioxidant Status). To measure the level of respective biochemical parameters in the blood serum (total protein, cholesterol, HDL and LDL fractions, glucose, triglycerides), BioMaxima reagent kits (Poland) were used. On the other hand, the TAS determination was done using a Randox (UK)

reagent kit. The absorbance measurement was made using a Marcel® PRO (Bio) (Poland) spectrophotometer.

Numerical data obtained in the experiment were analysed statistically using Statistica PL 9 computer software package. Analyses of the significance of statistical differences between the mean values of examined traits in the control group and experimental group porkers were made by means of Student's t-test.

RESULTS

As the results presented in Table 2 show, 80 mg · kg^{-1} feed mixture addition of active plant substances did not have ant significant effect on fattening and slaughter performance. Experimental group animals (APS), receiving carvacrol, capsaicin and cinnamaldehyde in their feed, were characterised by slightly higher daily body weight gain and slightly better feed conversion ratio when compared to the control group. The APS group animals also obtained slightly higher slaughter body weight and carcass slaughter value.

Table 2. Results of fattening performance and some indices of carcass traits

Tabela 2. Wyniki użytkowości tucznej i wybrane wskaźniki jakości tusz

Traits Cechy	Groups – Grupy		SEM
	Control – Kontrolna	APS – APS	
Initial body weight, kg Początkowa masa ciała, kg	36.1	35.4	0.27
Weight at slaughter, kg Masa ciała w dniu uboju, kg	101.3	102.2	0.59
Daily body gain, kg Przyrost dzienny, kg	0.80	0.82	0.062
Feed conversion ratio, kg · kg^{-1} Wykorzystanie paszy, kg · kg^{-1}	3.23	3.14	0.076
Loin eye area, cm^2 Powierzchnia oka polędwicy, cm^2	59.6	60.2	0.81
Backfat thickness, mm Grubość słoniny, mm	14.9	14.7	0.06
Meatiness, % Mięsność, %	56.1	56.7	0.68
Dressing, % Wydajność rzeźna, %	78.4	79.5	0.48

The application of active plant substances preparation significantly affected some blood serum biochemical indices (Table 3). Total cholesterol concentration in the blood serum of control and experimental porkers was at a similar level. However, this additive contributed to a significant decrease in LDL cholesterol

Table 3. Effect of plant extracts on some biochemical traits in pigs serum

Tabela 3. Wpływ ekstraktów roślinnych na wybrane parametry biochemiczne surowicy świń

Traits Cechy	Groups – Grupy		SEM
	Control – Kontrolna	APS – APS	
Total cholesterol, mmol · l^{-1} Cholesterol całkowity, mmol · l^{-1}	2.03	2.02	0.747
HDL-cholesterol, mmol · l^{-1} Cholesterol HDL, mmol · l^{-1}	0.55	0.63**	0.000
LDL-cholesterol, mmol · l^{-1} Cholesterol LDL, mmol · l^{-1}	1.35	1.23*	0.098
Triglicerydes, mmol · l^{-1} Triglicerydy, mmol · l^{-1}	0.32	0.31	0.002
Glukose, mmol · l^{-1} Glukoza, mmol · l^{-1}	3.98	4.20	0.005
Protein, g · l^{-1} Białko, g · l^{-1}	58.90	64.40**	0.914
Total antioxidant status, mmol · l^{-1} Całkowity status antyoksydacyjny, mmol · l^{-1}	0.79	0.94*	0.791

Significant effect of plant extracts: **P ≤ 0.01;*P ≤ 0.05.
Istotny wpływ ekstraktów roślinnych: **P ≤ 0,01;*P ≤ 0,05.

concentration (P ≤ 0.05) and a significant increase in HDL fraction concentration (P ≤ 0.01). The APS group porkers were characterised by a slightly elevated glucose concentration and significantly higher protein concentration (P ≤ 0.01) in blood in relation to the control group. The group receiving carvacrol, capsaicin and cinnamaldehyde also showed significantly higher antioxidant activity in the blood serum (P ≤ 0.05) in relation to the control group.

DISCUSSION

In this study, a significant effect of carvacrol, capsaicin and cinnamaldehyde on pigs fattening and slaughter values has not been shown. Also in the study by Batorska et al. [2003], evaluating the effect of herbal preparation, the value of fattening and slaughter performance traits in control and experimental group were similar. On the other hand, a significant effect of active plant substances addition on the fattening results and the slaughter value of pigs was shown in the studies of other authors [Korniewicz et al. 2007 b, Czech et al. 2009], where increased daily body weight gains, better feed conversion ratio and an increase in meatiness and loin eye area were observed. Some authors [Manzanilla et al. 2004, Hashemi and Davodi 2011] showed that the most important mechanism of phytobiotic action refers to intestinal microflora by controlling potential pathogens, which in turn is associated with better nutrient absorption through the improvement of digestive

capacity. No effect of the preparation being applied on the production results may confirm an existing view that with good environmental conditions and good herd health state the effect of applied active substances does not manifest itself.

On the other hand, this study has shown a beneficial effect of herbal extracts on lipid metabolism, being expressed by a significant decrease in the level of LDL fraction and a significant increase in the concentration of high density lipoproteins (HDL). Similar results were obtained in the studies of other authors [Grela 2000, Korniewicz et al. 2007, Poracova et al. 2011]. An increase in the concentration of HDL fraction in the blood serum may result from the activity of phenolic compounds contained in plant extracts and herbs [Miller et al. 2008]. In the experimental group, a slight increase in glucose concentration and a significant increase in protein concentration were also observed ($P \leq 0.01$). Also in the study by Korniewicz et al. [2007], the effect of active plant substances additive applied in pig fattening on better utilisation of nutrients, being reflected by higher total protein and glucose concentrations in the blood serum, was shown. Higher protein and glucose concentrations in the blood serum of porkers receiving plant extracts may result from better utilisation of nutrients, which was confirmed in other studies [Ilsley et al. 2003, Korniewicz et al. 2007 a]. In the experimental group, carvacrol, capsaicin and cinnamaldehyde also contributed to a significant increase in total antioxidant status (TAS) ($P \leq 0.05$) when compared to the control group porkers. The antioxidant action of these active substances was also shown in studies on rabbits [Szabóová et al. 2012].

CONCLUSIONS

Application of carvacrol, capsaicin and cinnamaldehyde in this study during the fattening period did not have any significant effect on the improvement of pigs production results and carcass slaughter value. However, a statistically significant effect of these additives on lipid metabolism was observed, inducing a decrease in the LDL cholesterol fraction and an increase in the HDL one, as well as an increase in the protein concentration and an improvement of antioxidant properties in the blood of pigs.

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WPŁYW DODATKU ROŚLINNYCH SUBSTANCJI AKTYWNYCH NA UŻYTKOWOŚĆ TUCZNĄ I RZEŹNĄ ORAZ PARAMETRY BIOCHEMICZNE SUROWICY ŚWIŃ

Streszczenie. Badania przeprowadzono na 70 tucznikach mieszańcach podzielonych na dwie grupy: I – kontrolną i II – doświadczalną, która otrzymywała dodatek roślinnych substancji aktywnych (aldehyd cynamonowy, karwakrol i kapsaicynę), w ilości 80 mg do 1 kg mieszanki. W trakcie doświadczenia oceniono użytkowość tuczną i rzeźną oraz wskaźniki biochemiczne surowicy w tym całkowity status antyoksydacyjny TAS (Total Antioxidant Status). Zastosowanie roślinnych substancji aktywnych w okresie tuczu nie wpłynęło na poprawę użytkowości tucznej oraz wartości rzeźnej tusz. Stwierdzono natomiast statystycznie istotny wpływ tego dodatku na gospodarkę lipidową, na co wskazuje obniżenie stężenia frakcji LDL ($P \leq 0{,}05$) oraz podwyższenie stężenia frakcji HDL ($P \leq 0{,}01$). Kapsaicyna, aldehyd cynamonowy i karwakrol spowodowały również istotny wzrost stężenia białka ($P \leq 0{,}01$) oraz całkowitego statusu antyoksydacyjnego ($P \leq 0{,}05$) w surowicy tuczników.

Słowa kluczowe: ekstrakty roślinne, status antyoksydacyjny, surowica, świnie, tucz

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