

**THE EFFECT OF DIETARY SUPPLEMENTATION WITH
A BLEND OF HERBAL EXTRACTS
AND ALUMINOSILICATES ON NUTRIENT
DIGESTIBILITY AND THE GROWTH PERFORMANCE
OF WEANED PIGLETS**

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Key words: pigs, nutrition, herbal extract, aluminosilicates, apparent digestibility, growth performance.

Abstract

Two complete diets for weaned piglets were analyzed. Control diet I was composed of soybean meal, ground barley, ground wheat, premix and acids. Experimental diet II was supplemented with 0.1% Vilocym, a blend of herbal extracts (*Azadirachta indica*, *Curcuma longa*, *Allium sativum*, *Andrographis paniculata*, *Solanum nigrum*) and sodium-calcium aluminosilicates. Nutrient digestibility was determined by a simple balance method, on 16 young barrows [(Polish Large White x Polish Landrace) x Duroc] with average initial body weight of 25 kg, assigned to two dietary treatments. A five-day experimental period proper was preceded by a seven-day adjustment period. A production trial was carried out on a pig farm, and it involved 240 weaners with average initial body weight of 20.5 kg, divided into two groups. Each group comprised four pens, with 30 animals per pen. The experiment lasted 30 days. Dietary supplementation with herbal extracts and aluminosilicates improved the digestibility of crude fat, total protein and organic matter. Weaned piglets fed Vilocym were characterized by higher daily gains than control group animals (725 g vs. 665 g, $P \leq 0.05$). Feed consumption per kg body weight gain was significantly lower in group II (2.14 g/kg vs. 2.33 g/kg, $P \leq 0.05$).

WPLYW DODATKU MIESZANINY EKSTRAKTU Z ZIOŁ I GLINOKRZEMIANÓW NA STRAWNOŚĆ SKŁADNIKÓW POKARMOWYCH I WYNIKI ODCHOWU WARCHLAKÓW

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Słowa kluczowe: świny, żywienie, ekstrakt ziołowy, glinokrzemiany, strawność pozorna, odchów.

Abstrakt

Badano dwie mieszanki pełnoporcjowe przeznaczone dla warchlaków. W skład mieszanki kontrolnej (I) wchodziła śruta poekstrakcyjna sojowa, śruta jęczmienna, śruta pszena, premiks oraz preparat zakwaszający. Mieszanka doświadczalna (II) zawierała ponadto 0,1% preparatu Vilocym, który był mieszaniną ekstraktów z ziół (*Azadirachta indica*, *Curcuma longa*, *Allium sativum*, *Andrographis paniculata*, *Solanum nigrum*) i glinokrzemianów wapniowo-sodowych. Badania strawności składników pokarmowych przeprowadzono metodą bilansową bezpośrednią na 16 wieprz-kach [(wbp x pbz) x duroc] o średniej początkowej masie ciała 25 kg podzielonych na dwie grupy. Okres wstępny trwał 7 dni, a właściwy 5 dni. Badania produkcyjne przeprowadzono na fermie tuczu trzody chlewnej na 240 warchlakach o początkowej masie ciała 20,5 kg, podzielonych na dwie grupy. Jedną grupę stanowiły zwierzęta umieszczone w 4 kojcach po 30 sztuk w każdym. Okres badań trwał 30 dni. Wprowadzenie do mieszanki dla warchlaków dodatku ekstraktu z ziół i glinokrzemianów wpłynęło na poprawę strawności tłuszczu surowego, białka ogólnego i substancji organicznej. Stwierdzono także wyższe przyrosty dobowe masy ciała u warchlaków otrzymujących mieszankę z dodatkiem preparatu Vilocym w porównaniu z grupą kontrolną (725 g vs. 665 g, $P \leq 0,05$). Wykorzystanie paszy na kg przyrostu również było u warchlaków grupy II istotnie lepsze (2,14 g/kg vs. 2,33 g/kg, $P \leq 0,05$).

Introduction

Due to the ban on the use of antibiotics as feed additives in pig production, producers have to search for alternatives to antibiotic growth promoters in pig diets. Alternative additives are expected to naturally enhance the immune system of animals, and to stabilize the gut microflora. Herbs and essential oils have been shown to modulate the gut microflora (HASHEMI and DAVOODI 2011, YANG et al. 2009). Glycosides, tannins, essential oils and saponins contained in herbal plants can naturally increase appetite, stimulate peristalsis and the secretion of gastric acid (NAMKUNG et al. 2004, WINDISCH et al. 2008). Numerous plants contain natural antimicrobial agents that strongly suppress the growth of pathogenic bacterial strains (HASHEMI and DAVOODI 2011). In a study by MANZANILLA et al. (2004), piglets weaned at 21 days of age were fed diets supplemented with plant extracts, alone or in combination with formic acid. The supplements were effective in modifying the gastrointestinal system, stomach contents and stomach emptying rate. Yucca saponins added

to animal feed have been shown to reduce ammonia production and excretion (FRANCIS et al. 2002). Research results also indicate that dietary supplementation with herbal extracts could affect nutrient digestibility in monogastric animals (HERNANDEZ et al. 2004, NAMKUNG et al. 2004, GERRITSEN et al. 2010). As demonstrated by YAN et al. (2011), herbal extracts influence the serum levels of LDL, HDL, total cholesterol and triacylglycerols in finishing pigs.

The objective of this study was to determine nutrient digestibility and the growth performance of weaned piglets fed a diet supplemented with a blend of herbal extracts and sodium-calcium aluminosilicates.

Materials and Methods

Two complete diets for weaned piglets were analyzed. The diets, formulated in accordance with the pig nutrient requirements (*Normy żywienia...* 1993), were composed of soybean meal, ground barley, ground wheat, premix and acids. Experimental diet II was supplemented with Vilocym (1 kg t⁻¹, 0.1%), a blend of herbal extracts (*Azadirachta indica*, *Curcuma longa*, *Allium sativum*, *Andrographis paniculata*, *Solanum nigrum*) and natural sodium-calcium aluminosilicates (Table 1).

Table 1

Composition [%] and calculated feeding value of experimental diets

Specification	Diets	
	I	II
Ingredients		
Ground wheat	45.70	45.60
Ground barley	30.00	30.00
Soybean meal	20.00	20.00
Premix*	4.00	4.00
Acids	0.30	0.30
Vilocym	–	0.10
Calculated nutrient profile	–	–
Metabolizable energy [MJ kg ⁻¹]	–	–
Crude protein [%]	13.03	13.01
Lysine [%]	19.30	19.30
Methionine [%]	1.28	1.28
Threonine [%]	0.73	0.73
Tryptophan [%]	0.80	0.80
Calcium [%]	0.23	0.23
Available phosphorous [%]	0.84	0.85
Salt [%]	0.46	0.46
	0.20	0.20

* lysine – 10.5%, methionine – 3%, threonine – 4%, Ca – 17.2%, P – 5.5%, available P – 3.26%, Na – 4.4%, Vit. A – 400 000 IU, Vit. D₃ – 50 000 IU, Vit. E – 3 004 mg, Vit. K₃ – 100 mg, Vit. B₁ – 60 mg, Vit. B₂ – 160 mg, Vit. B₆ – 120 mg, Vit. B₁₂ – 1 mg, niacin – 800 mg, pantothenic acid – 400 mg, folic acid – 80 mg, biotin – 4 mg, choline – 10 000 mg, Mn – 1 800 mg, Zn – 4 000 mg, Fe – 3 500 mg, Cu – 4 000 mg, I – 40 mg, Co – 20 mg, Se – 20 mg, enzyme (+)

Nutrient digestibility was determined by a simple balance method, on 16 young barrows [(Polish Large White x Polish Landrace) x Duroc] with average initial body weight of 25 kg, assigned to two dietary treatments by the analogue method. The animals were kept in individual metabolism cages. A five-day experimental period proper was preceded by a seven-day adjustment period. The weaners were fed twice daily, at 7.00 a.m. and 3.00 p.m., and they had free access to drinking water.

A production trial was carried out on a pig farm, and it involved 240 hybrid weaners [(Polish Large White x Polish Landrace) x (Duroc x Pietrain)] with average initial body weight of 20.5 kg, divided into two experimental groups. Each group comprised four pens, with 30 animals per pen. The experiment lasted 30 days. The animals were fed dry feed *ad libitum*. Feed intake and the health status of weaners were monitored throughout the experiment. The animals were weighed at the beginning and at the end of the experiment. The following growth performance parameters were determined: total body weight gain (TBG), average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR).

The nutrient content of feed and feces was determined by the Weende analysis (AOAC, 2000). The gross energy content of feed and feces was determined using an adiabatic bomb calorimeter. The metabolizable energy content of diets was calculated using the equations proposed by Hoffman and Schiemann (*Normy żywienia...* 1993), based on proximate chemical composition and coefficients of nutrient digestibility.

The results were processed statistically by one-way ANOVA and Duncan's test. Arithmetic means (\bar{x}), standard errors of the mean (SEM) and significance level (P) were calculated with the use of STATISTICA 7 software.

Results and Discussion

The proximate chemical composition of pig diets is presented in Table 2. The total protein content of diets I and II was 18.08% and 18.09%, respectively, and it corresponded to the pig nutrient requirements (*Normy żywienia...* 1993). The metabolizable energy content of diets, calculated based on chemical composition and digestibility coefficients, was 12.10 MJ kg⁻¹ in control group I and 12.42 MJ kg⁻¹ in experimental group II. Both values were lower than recommended in the pig nutrient requirements (*Normy żywienia...* 1993) (12.7 MJ kg⁻¹).

Table 3 shows the coefficients of nutrient digestibility determined in the study. A blend of herbal extracts and aluminosilicates, added to the complete experimental diet for weaners, had a statistically significant effect on nutrient

Table 2

Chemical composition and nutritive value of experimental diets

Specification	Diets	
	I	II
Dry matter [%]	88.34	88.68
Crude ash [%]	4.33	4.55
Organic matter [%]	84.01	84.13
Crude protein [%]	18.09	18.08
Crude fat [%]	1.55	1.66
Crude fiber [%]	3.45	3.26
N-free extractives [%]	60.92	61.13
Metabolizable energy [MJ kg ⁻¹]	60.92	61.13

Table 3

Apparent fecal digestibility coefficients [%]

Specification	Diets		SEM	P
	I	II		
Organic matter	83.47 ^b	84.82 ^a	0.366	0.019
Crude protein	77.14 ^b	78.81 ^a	0.349	0.039
Crude fat	55.29 ^B	64.90 ^A	2.816	0.006
Crude fiber	32.45	35.45	0.912	0.063
N-free extractives	89.68	90.12	0.280	0.516
Gross energy	80.92	81.92	0.275	0.097

a b - $P \leq 0.05$ *AB* - $P \leq 0.01$

digestibility. A significant increase in total protein digestibility was noted. KONG et al. (2009), who studied the effects of *Acanthopanax senticosus* extracts (1 g/kg feed) on the apparent ileal digestibility of amino acids in weaned piglets, reported that the supplement enhanced the digestibility of lysine, methionine, isoleucine, histidine, threonine, arginine, cysteine and valine. The ileal digestibility of some amino acids (isoleucine, leucine, threonine, valine) was higher in piglets fed the AS extract-supplemented diet than in those receiving an antibiotic.

In the present study, a significant increase in crude fat digestibility was also noted in weaned piglets fed a Vilocym-supplemented diet. The coefficient of crude fat digestibility increased from 55.29% in the control group to 64.90% in experiment group animals fed a diet supplemented with herbal extracts (Table 3). Organic matter digestibility also improved in the experimental group. MANZANILLA et al. (2004) examined the apparent ileal and fecal digestibility of organic matter in pigs weaned at 21 days of age, fed a mixture of plant extracts (oregano, cinnamon, Mexican pepper), alone or in combination with

formic acid. An increase in organic matter digestibility was reported only in the group receiving plant extracts. In an experiment conducted by GERRITSEN et al. (2010), piglets weaned at 26 days of age were fed (from 9 kg to 18 kg BW) diets supplemented with essential oils (thyme, oregano, cloves) and formic acid or a blend of organic acids. The combination of essential oils and formic acid insignificantly enhanced the digestibility of total protein and crude fat, and significantly increased crude fiber digestibility. YAN et al. (2011) observed no effect of *Saururus chinensis* extract supplementation on the digestibility coefficients of dry matter, total protein and energy in pigs (ca. 54 kg BW).

Table 4 shows the results of a production trial that involved growing pigs. The average initial body weight of animals was 20.5 kg in both groups. No disease symptoms were observed in weaners over a 30-day experiment, and their survival rate reached 100%. After 30 days, the average body weight of weaners was 39.87 kg in the control group and 42.27 kg in the experimental group. The inclusion of 0.1% herbal extracts and aluminosilicates in pig diets had a significant effect on average daily gains, which reached 725 g in group II and 645 g in group I. The growth rate of weaned piglets was relatively high, and comparable with that noted in previous studies (BUGNACKA and FALKOWSKI 2001). PASCHMA and KACZOR (2008) added a herbal mixture (chamomile, stinging nettle, caraway, fennel) at 1% and 1.5% to a diet for sows, from 100 days of pregnancy to 21 days of lactation, and found that piglets aged 21 days were characterized by high body weights in the experimental group, compared with the control group. KONG et al. (2007) and FANG et al. (2009) studied the effects of Chinese herbal ultra-fine powder and *Acanthopanax senticosus* extracts as dietary additives for early-weaned piglets, and reported that the above supplements improved daily gains and the gain/feed ratio, and reduced the incidence of diarrhea in piglets. LIPIŃSKI and TYWOŃCZUK (2008) also observed an improvement in the production parameters of piglets fed diets supplemented with *Macleaya mordata* extract.

Table 4

The effect on the growth performance of pigs

Specification	Diets		SEM	<i>P</i>
	I	II		
No. of pigs	120	120		
Days of experiment	30	30		
Initial weight [kg]	20.50	20.50	0.180	1.000
Final weight [kg]	39.87 ^b	42.27 ^a	0.630	0.031
TBG [kg]	19.37 ^b	21.77 ^a	0.603	0.017
ADG [g/day]	645 ^b	725 ^a	20.083	0.017
ADFI [kg/day]	1.50	1.55	0.017	0.258
FCR [kg/kg]	2.33 ^b	2.14 ^a	0.049	0.021

a b – $P \leq 0.05$

Significantly better feed conversion efficiency was noted in experimental group animals fed Vilocym (2.14 kg/kg on average), in comparison with the control group (2.33 kg/kg).

Conclusions

Dietary supplementation with herbal extracts and aluminosilicates (Vilocym) improved the digestibility of crude fat, total protein and organic matter. Weaners fed Vilocym were characterized by higher daily gains (by 12%) and better feed conversion, compared with control group animals.

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