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Effects of dietary supplementation of Jerusalem artichoke (*Helianthus tuberosus* L.) on performance of weaning pigs and manure ammonia nitrogen concentration

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Abstract

One hundred ninety-two weaning pigs equal sex , 21 d of age were fed diets containing 0, 1, 2 or 3% raw Jerusalem artichoke (JA) tubers for 5 weeks. Feed intake, total weight gain and average daily gain (ADG) were not significant affected by diets but showed trend increasing in ADG and decreased in feed in take. Feed efficiency was significantly ($P<0.05$) affected by the addition of JA to the diets. The weaning pigs fed the diets containing JA had significantly ($P<0.05$) decreased ammonia nitrogen in their manure; pigs receiving the 3% JA diets had the lowest ammonia nitrogen for all periods of testing (1,2,3 and overall1-3wk periods). Addition of 3% JA in the weaning diet is benificial in increasing weight gain and reduced ammonia nitrogen or odour of manure.

Keywords : Jerusalem artichoke, weaning pigs, performance, ammonia nitrogen, weaning ping, odour

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บทคัดย่อ

ใช้ลูกสุกรอายุ 21 วัน จำนวน 192 ตัว มาทดสอบด้วยอาหารที่เสริมด้วยแก่นตะวัน (Jerusalem artichoke, JA) ที่ระดับ0, 1, 2 และ 3% เป็นเวลา 5 สัปดาห์ ผลการทดลอง พบว่า ปริมาณอาหารที่กิน น้ำหนักเพิ่มทั้งหมดและอัตราการเจริญเติบโตต่อวัน พบว่า ไม่มีผลแตกต่างกันต่อทุกสูตรอาหารที่ทดสอบแต่จะแสดงแนวโน้มว่าอัตราการเจริญเติบโตเพิ่มขึ้นและปริมาณอาหารที่กินลดลง เมื่อเสริมแก่นตะวัน ประสิทธิภาพการใช้อาหารจะดีขึ้นอย่างมีนัยสำคัญ ($P<0.05$) เมื่อเสริมแก่นตะวันในสูตรอาหาร การเสริมแก่นตะวันในอาหารลูกสุกรหย่านมจะมีผลต่อการลดลงของแกสแอมโมเนียในมูลอย่างมีนัยสำคัญ ($P<0.05$) อย่างเด่นชัด โดยเฉพาะมูลลูกสุกรหย่านมที่เสริมด้วยแก่นตะวัน 3% ในสูตรอาหารจะมีค่าแอมโมเนียไนโตรเจนในมูลลูกสุกรหย่านมต่ำที่สุด ตลอดทุกช่วงเวลาที่ทดสอบ (1, 2, 3 และตลอดการทดลอง 1-3 สัปดาห์) การเสริมแก่นตะวัน ในระดับ 3% ในสูตรอาหารลูกสุกรหย่านมจะให้ประโยชน์ต่อการเพิ่มขึ้นของน้ำหนักตัวและลดกลิ่นแกสแอมโมเนียในมูลลงได้

คำสำคัญ: แก่นตะวัน (Jerusalem artichoke), ลูกสุกรหย่านม, สมรรถนะการผลิต, แอมโมเนียไนโตรเจน, กลิ่น

Introduction

Jerusalem artichoke (JA) carbohydrate rich in fructooligosaccharide (FOS) has been reported to bring about several metabolic and physiological changes in pigs and chickens including improvements in feed efficiency, reduce diarrhea, and reduce smell in feces, that has been attributted to be a change in the make-up of the intestinal microflora population (Modler et al. 1990; Gibson et al. 1995). Recent research has examined the use of JA flour as a replacement for grain in the diets of weaning pigs (Farnworth 1994; Farnworth et al. 1995). The purpose of this study was to determine the effect of adding JA tuber powder in weaning pigs diet on performance and their effect on manure ammonia nitrogen concentration.

Materials and Methods

A total of 192,21 -d-old weaning pigs (Landrace-Yorkshire X Duroc) form a well manage commercial farm in Khon Kaen Province were equally in sex on the basis of gender and body weight were used in each treatment with 2 replications of 12 pigs each (2 replications for males and 2 replications for females). The diets were supplemented with 0, 1, 2 or 3 % JA for replacement of broken rice. Basal diet contain 18% crude protein, 3295 kcalME/kgdiet, 1% Ca, 0.53% available P, 0.68% Met+Cyc, 1.22% Lys, 0.78% Thr and 0.22% Tryp (Table 1). All pigs were house in environmentally regulated nusery pen and given ad libitum access to feed and water throughout the study (21-56 d of age). Animal were weighted at initial and final weight. Feed intake was recorded every day. Manure sample from each pen were obtained at the end of each week. Sample were kept frozen until

analyzed for ammonia nitrogen by method of A.O.A.C. (1995). A completely randomized design was applied using The GLM procedure of SAS (1985) and differences between treatments were tested using Duncan's multiple range test.

Results and Discussion

The effects of different dietary JA levels on performance of weaning pigs are presented in Table 2. Pigs receiving raw JA tubers with 1 to 3 % inclusion consumed less feed ($P>0.05$) but grew or grained faster ($P>0.05$) and significantly better ($P<0.05$) feed efficiency (feed/grain) for the whole period of the 35 days feeding trial than those the control group. The results of this study were confirmed the results of Farnworth (1994) and Farnworth et al. (1995). The feed efficiency of pigs eating the JA supplemental diets at 1% being the most efficient but did not significantly when compared with the 2 and 3% JA supplemented groups. The pigs eating the diet contain JA had significantly ($P<0.05$) decreased ammonia nitrogen in their manure for all period of testing (1, 2, 3 and overall, 1-3 wk) which might indicated that the intensity of the odour of manure from pigs fed JA less than manure from pigs fed a control diet which has been reported by Farnworth et al. (1993). The largest average daily weight gain (ADG) was observed for the group eating the diet containing the 3% JA, although no statistical differences ($P>0.05$) due to diet were

Table 1 Composition of the experimental diets

Ingredients	Jerusalem artichoke, %			
	0	1	2	3
Broken rice	56.18	55.18	54.18	53.18
Jerusalem artichoke	0.00	1.00	2.00	3.00
Fish meal	5.00	5.00	5.00	5.00
Sweet whey	10.00	10.00	10.00	10.00
Skim milk replacer	5.00	5.00	5.00	5.00
Crude rice oil	3.01	3.01	3.01	3.01
Soybean meal	8.80	8.80	8.80	8.80
Full fat soybean	10.00	10.00	10.00	10.00
DL-Methionine	0.015	0.015	0.015	0.015
L-Lysine	0.20	0.20	0.20	0.20
Threonine	0.015	0.015	0.015	0.015
Monocalcium phosphate	1.40	1.40	1.40	1.40
Premixes[a]	0.25	0.25	0.25	0.25

[a]Premixes provide per kilogram of diet : A 2,500 IU, D3 250 IU, E 20 IU, B12 0.2 mg, Pantothenic acid 12 mg, Niacin 20 mg, Riboflavin 4 mg, Thiamine 2 mg, Choline chloride 1 g, Pyridoxine 2 mg, Biotin 0.3 mg, K3 0.5 mg, Folic acid 0.3 mg, Etoxyquin 12.5 mg, Cu 250 mg, I 0.4 mg, Fe 100 mg, Se 0.3 mg, Zn 100 mg, Co 0.14 mg, Tylosin 110 mg, Chlotetracycline 200 mg and Amoxylin 150 mg.

Table 2 Effects of dietary supplementation of Jerusalem artichoke on performance and manure ammonia nitrogen in weaning pigs

Dietary	Jerusalem artichoke, %				Pooled SEM	Orthogonal regression*
	0	1	2	3		
Initial Wt (kg)	7.12	7.00	6.97	7.01		
Final Wt (kg)	21.23	21.91	21.32	22.34		
Weight gain (kg)	14.12	14.91	14.35	15.33	1.425	NS
ADG (kg/Head/day)	0.403	0.426	0.410	0.438	0.325	NS
FI (kg/Head/day)	0.746	0.681	0.719	0.786	0.068	NS
Feed/Gain	1.847^{a}	1.602^{b}	1.748^{ab}	1.662^{b}	0.096	C
Ammonia nitrogen (mg/l)						
Wk1	40.25^{a}	29.50^{b}	32.12^{b}	29.50^{b}	2.334	L,Q,C
Wk2	39.25^{a}	28.88^{b}	32.00^{b}	30.63^{b}	4.098	L,Q
Wk3	44.63^{a}	31.50^{b}	32.22^{b}	26.63^{c}	2.726	L,Q,C
Overall	124.13^{a}	89.88^{bc}	96.33^{b}	86.75^{c}	5.574	L,Q,C

^{abc}Mean with the same column with no common superscript differ significantly ($P<0.05$)
L,Q,C indicate that the linear, quadratic or cubic of treatment is significantly ($P<0.05$)
NS = non significantly

found the best value for feed efficiency was observed for the group eating the diet containing the 1% JA and there was a cubic ($P<0.05$) relationship with diets. Feeding the 3% JA is benificial in increasing weight grain and also reducing the odour of manure in weaning pigs.

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