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Abstract

Two trials were conducted to determine the effects of irradiation of spray-dried blood meal and animal plasma on nursery pig growth performance. In Exp. 1, irradiation of spray-dried blood meal resulted in improved ADG and F/G and tended to increase ADFI for the 14 d experiment. The majority of the increase in growth performance occurred during the first week of the trial. In Exp. 2, ADG and ADFI were increased from d 0 to 10 for pigs fed irradiated spray-dried animal plasma compared to pigs fed regular spray-dried animal plasma. In addition, we observed differences in growth performance between different sources of spray-dried plasma used in this experiment.; Swine Day, Manhattan, KS, November 16, 2000

Keywords

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EFFECTS OF IRRADIATION OF SPRAY-DRIED BLOOD MEAL AND ANIMAL PLASMA ON NURSERY PIG GROWTH PERFORMANCE

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Summary

Two trials were conducted to determine the effects of irradiation of spray-dried blood meal and animal plasma on nursery pig growth performance. In Exp. 1, irradiation of spray-dried blood meal resulted in improved ADG and F/G and tended to increase ADFI for the 14 d experiment. The majority of the increase in growth performance occurred during the first week of the trial. In Exp. 2, ADG and ADFI were increased from d 0 to 10 for pigs fed irradiated spray-dried animal plasma compared to pigs fed regular spray-dried animal plasma. In addition, we observed differences in growth performance between different sources of spray-dried plasma used in this experiment.

(Key Words: Nursery Pig, Irradiation, Blood Meal, Animal Plasma.)

Introduction

Research shows that the inclusion of spray-dried blood products to nursery diets improves growth performance. However, different manufacturers of blood by-products utilize various types of drying and processing techniques. Past research at Kansas State University has shown a large amount of variation in spray-dried blood products within and between manufacturers. Most blood products that are commercially available are spray-dried. That processing method exposes the product to heat, which may decrease protein quality. Irradiation processing of these blood products may cause a decrease in antinutritional factors or cause structural changes within the protein, aiding in digestibility of the blood products. Therefore, our objective was to determine the effects of irradiation processing of different blood products on nursery pig growth performance.

Procedures

Experiment 1. This experiment was conducted in conjunction with an experiment to determine the impact of pH of blood meal on pig performance reported in the previous article. A total of 60 pigs (BW of 13.8 and 17 ± 2 d of age) was used in a 19-d growth assay. Pigs were blocked by weight and allotted to one of two dietary treatments. There were five pigs/pen and six pens/treatment. Pigs were housed in the Kansas State University Segregated Early Weaning Facility. Each pen was 4 × 4 ft and contained one self-feeder and one nipple waters to provide ad libitum access to feed and water. Initial temperature was 90°F for the first 5 d and was lowered approximately 3°F each week thereafter.

All pigs were fed the same pelleted SEW diet (Table 1) to 5 d postweaning. Then the pigs were switched to experimental diets containing 5% spray-dried blood meal or spray-dried blood meal that had been irradiated. All blood meal originated from the same lot. The spray-dried blood meal was irradiated at an average dose of 9.54 kGy (24 doses with a 7.2 kGy minimum and 11.8 kGy maximum dose).

Treatment diets were fed in meal form and formulated to contain 1.40% lysine, .90 Ca, and .54 available P. Diets also were balanced for Na and Cl concentrations (Table 1). Average daily gain, ADFI, and F/G were

[1]Food Animal Health and Management Center.

determined by weighing pigs and measuring feed disappearance on d 5 after weaning and on d 7 and 14 (d 12 and 19 after weaning) of the treatment period. Blood meal samples were taken for analysis to determine bacterial concentrations prior to manufacturing of the complete diet.

Experiment 2. A total of 180 pigs (BW of 13.1 lb and 17 ± 2 d of age) was used in a 24 d growth assay to determine the effects of source, processing technique, and irradiation of spray-dried animal plasma on nursery pig performance. There were five pigs/pen and six pens/treatment. Pigs were housed in an environmentally controlled nursery in 5 × 5 ft pens located at the Kansas State University Swine Teaching and Research Center. All pens contained one self-feeder and nipple water to provide ad libitum access to feed and water.

Treatment diets were fed in meal form from d 0 to 10, and included a control diet containing no animal plasma and five additional diets containing 5 % spray-dried animal plasma from two different sources and processing techniques. From source 1, treatment diets consisted of plasma that had been spray-dried, spray-dried then irradiated, or freeze dried then irradiated. From source 2, treatment diets consisted of plasma that had been spray-dried or spray-dried then irradiated. The spray-dried animal plasma was irradiated at an average dose of 9.75 kGy (8 doses with a 9.50 kGy minimum and 10.00 kGy maximum dose). All treatment diets were formulated to contain 1.50% lysine, .89 Ca, and .54 available P. Diets also were balanced for Na and Cl concentrations (Table 1). A common Phase II diet was fed from d 10 to 24 (Table 1). The ADG, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 5, 10, and 24 after weaning. Spray-dried animal plasma samples were taken prior to manufacturing of the complete diet, and feed samples were obtained at the initiation of the experiment for analysis to determine bacterial concentrations within each treatment.

Results and Discussion

Experiment 1. From d 0 to 7, pigs fed irradiated spray-dried blood meal had improved (P<.03) ADG and ADFI and tended (P<.13) to have improved feed efficiency (Table 2). From d 7 to 14, both ADG and F/G (P<.09) improved moderately with irradiated spray-dried blood meal, but ADFI was not affected. For the entire treatment period, pigs fed irradiated spray-dried blood meal had improved (P<.02) ADG and F/G and showed a tendency to increase food intake (P<.13). Irradiation of the spray-dried blood meal reduced the bacterial concentration from 6.6×10^6 to 9.0×10^1.

Experiment 2. From d 0 to 5, pigs fed irradiated spray-dried animal plasma had increased ADG (P<.05) and ADFI (P<.10) compared to those fed regular spray-dried animal plasma, regardless of source (Table 3). In addition, pigs fed source two nonirradiated plasma had improved ADG and F/G (P<.05) compared to those fed the control diet, whereas those fed spray-dried animal plasma source one did not. From d 5 to 10, pigs fed spray-dried animal plasma source 2 plasma had increased ADG and ADFI (P<.05) compared with the control diet without spray-dried animal plasma. For d 0 to 10, ADG (P<.05) and ADFI (P<.10) was greater for pigs fed irradiated spray-dried animal plasma versus animal plasma that was not irradiated. Freeze-dried and irradiated plasma did not improve growth performance compared to plasma from the same source that had been spray-dried then irradiated.

From d 10 to 24, ADFI was improved (P<.05) for pigs previously fed diets containing spray-dried animal plasma that was irradiated versus spray-dried animal plasma that was not. In addition, pigs fed irradiated spray-dried animal plasma were heavier (P<.05) at the conclusion of the trial compared to those fed the control diet, whereas pigs on the treatment diets with regular spray-dried plasma were not.

Irradiation reduced the bacterial concentration in the spray-dried animal plasma, regardless of source (Table 3). In addition, this proved to be beneficial in reducing the total bacteria load in the whole diet. However, the counts indicated that a lot of bacteria exist in other feed ingredients of the nursery diets.

In conclusion, irradiation of spray-dried blood meal and animal plasma improved growth performance. Whether the response to irradiated blood products was from a reduction in total bacterial concentration, an increase in digestibility of the protein portion, or another reason is unclear and needs to be investigated further. Freeze-dried then irradiated plasma showed no advantage over spray-dried then irradiated plasma, indicating that protein damage from heat occurring during the spray-drying process is not a concern and that freeze-drying offers no further benefits. Furthermore, differences between sources of spray-dried animal plasma were evident in our study.

Table 1. Compositions of Common and Experimental Diets (Exps. 1 & 2)

	Common		Exp. 1	Exp. 2	
Ingredient, %	SEW[a]	Phase II[b]	Blood Meal	No Plasma	Added Plasma
Corn	33.37	48.83	53.62	41.88	49.39
Soybean meal (46.5%)	12.80	29.00	26.43	37.68	25.71
Spray-dried whey	25.00	10.00	10.00	15.00	15.00
Lactose	5.00	-	-	-	-
Spray-dried animal plasma	6.70	-	-	-	5.00
Spray-dried blood meal	-	-	5.00	-	-
Spray-dried blood cells	1.65	2.50	-	-	-
Select menhaden fish meal	6.00	-	-	-	-
Choice white grease	5.00	-	-	-	-
Medication[c]	1.00	1.00	1.00	1.00	1.00
Monocalcium P (21% P)	.75	1.85	1.86	1.49	1.38
Limestone	.45	.95	.79	1.02	1.15
Salt	.20	.25	.30	.42	.30
Calcium chloride	-	-	.18	-	-
Sodium bicarbonate	-	-	-	.38	-
Zinc oxide	.38	-	.25	.39	.39
Vitamin premix	.25	.25	.25	.25	.25
Trace mineral premix	.15	.15	.15	.15	.15
L-Lysine HCl	.15	.15	-	.15	.15
DL-Methionine	.15	.07	.13	.16	.13
L-Threonine	-	-	.03	.03	-
L-Isoleucine	-	-	.01	-	-
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Lysine, %	1.70	1.40	1.40	1.50	1.50
Met:lysine ratio, %	30	28	33	34	30
Met & Cys:lysine ratio,%	57	55	60	60	60
Threonine:lysine ratio, %	65	65	67	64	64
Tryptophan:lysine ratio, %	18	20	21	20	19
ME, kcal/lb	1,595	1570	1449	1447	1468
Calcium, %	.90	.89	.90	.90	.90
Phosphorus, %	.80	.80	.81	.80	.80
Available phosphorus, %	.66	.54	.54	.50	.46
Sodium, %	.42	.23	.26	.43	.43
Chloride, %	.45	.39	.43	.53	.53

[a]Diet fed from d 0 to 5 after weaning in Exp. 1. [b]Diet fed from d 10 to 24 after weaning in Exp.2.
[c]Provided 50 g per ton carbadox.

Table 2. Effects of Irradiated Spray-Dried Blood Meal on Growth Performance of Nursery Pigs and Bacterial Concentrations[a]

	Blood Meal			
Item	Regular	Irradiated[b]	SE	Probability[c]
Initial weight, lb	15.16	14.82	.18	.21
d 0 to 7				
ADG, lb	.31	.43	.04	.03
ADFI, lb	.58	.69	.04	.03
F/G	1.87	1.60	.05	.13
d 7 to 14				
ADG, lb	.69	.82	.05	.09
ADFI, lb	.86	.92	.06	.46
F/G	1.25	1.12	.04	.09
d 0 to 14				
ADG, lb	.50	.62	.04	.02
ADFI, lb	.72	.80	.04	.13
F/G	1.44	1.29	.03	.02
Blood meal[d]				
Total plate count	6.6×10^6	9.0×10^1	—	—
Total coliform count	0	0	—	—

[a]A total of 60 pigs (five pigs per pen and six pens per treatment) with an average initial BW of 14.95 lb at the beginning of phase II. All pigs were fed a common SEW diet for the first 5 days. Thus, d 0 of the experiment is actually 5 d after weaning. Growth performance for the first 5 d after weaning was: ADG, .24 lb; ADFI, .23 lb; and F/G, .96.

[b]Irradiated at an average dose of 9.54 kGy (24 doses with a 7.2 kGy minimum and 11.8 kGy maximum dose).

[c]Initial pig weight (d 5 postweaning) was used as a covariate in the growth performance statistical analysis.

[d]Samples obtained prior to manufacturing of complete diet.

Table 3. Effects of Source, Processing Technique, and Irradiation of Plasma on Weanling Pig Growth Performance and Bacterial Concentrations[a]

Item	No Plasma Control	Plasma Source 1 Spray-Dried	Plasma Source 1 Spray-Dried and Irradiated	Plasma Source 1 Freeze-Dried and Irradiated	Plasma Source 2 Spray-Dried	Plasma Source 2 Spray-Dried and Irradiated	SEM
Initial wt, lb	13.10	13.09	13.07	13.09	13.02	13.10	
D 0 to 5							
ADG, lb[bd]	.49[f]	.49[f]	.62[g]	.60[g]	.59[g]	.71[h]	.03
ADFI, lb[e]	.46[f]	.47[f]	.52[f]	.48[f]	.47[f]	.62[g]	.04
F/G[c]	.94[f]	.96[f]	.84[fg]	.80[g]	.80[g]	.87[fg]	.05
D 5 to 10							
ADG, lb[b]	.56[f]	.62[fg]	.69[fg]	.67[fg]	.71[g]	.75[g]	.05
ADFI, lb[b]	.77[f]	.82[fg]	.91[fg]	.87[fg]	.97[g]	.98[g]	.05
F/G	1.38	1.32	1.32	1.30	1.37	1.31	.08
D 0 to 10							
ADG, lb[bd]	.53[f]	.56[fg]	.66[hi]	.64[gh]	.65[hi]	.73[i]	.03
ADFI, lb[be]	.62[f]	.65[f]	.72[fg]	.68[f]	.72[fg]	.80[g]	.04
F/G	1.17	1.16	1.09	1.06	1.11	1.10	.03
Pig wt, lb							
D 10[bd]	18.39[f]	18.60[fg]	19.62[hi]	19.45[gh]	19.51[hi]	20.37[hi]	.32
D 10 to 24							
ADG, lb	.88[f]	.88[f]	.89[f]	.76[g]	.79[g]	.82[fg]	.03
ADFI, lb[d]	1.08[fg]	1.00[f]	1.12[g]	.99[f]	.99[f]	1.06[fg]	.03
F/G	1.23[f]	1.14[g]	1.26[f]	1.30[f]	1.25[f]	1.29[f]	.04
Pig wt, lb							
D 24[be]	28.11[f]	29.71[fg]	31.27[g]	29.49[fg]	29.92[fg]	31.31[g]	.77
Spray-dried animal plasma[j]							
Total plate count	N/A	9.0×10^4	4.5×10^1	0	2.6×10^4	3.5×10^2	—
Total coliform count	N/A	0	0	0	0	0	—
Whole diet[k]							
Total plate count	3.7×10^4	1.0×10^4	3.1×10^2	6.8×10^3	1.0×10^4	7.6×10^3	—
Total coliform count	2.8×10^4	6.7×10^3	3.0×10^2	2.1×10^2	6.0×10^3	1.0×10^3	—

[a]A total of 180 pigs (five pigs per pen and six pens per treatment) with an average initial BW of 13.1 lb. [b]Control vs mean of plasma trts ($P<.05$). [c]Control vs mean of plasma trts ($P<.10$). [d]Spray-dried plasma vs spray-dried and irradiated plasma ($P<.05$). [e]Spray-dried plasma vs spray-dried and irradiated plasma ($P<.10$). [fghi]Means in same row with superscripts differ ($P<.05$). [j]Samples obtained prior to manufacturing of complete feed. [k]Samples obtained at initiation of the feeding experiment.