Dietary Spray-Dried Bovine Plasma Protein Improves Growth Performance and Breast-Meat Yield of Broilers Raised in a High-Antigen Environment

A.S. Leaflet R2019

K. Bregendahl, assistant professor of animal science
D. U. Ahn, associate professor of animal science,
D. W. Trampel, professor of veterinary medicine, and
J. M. Campbell, nutritionist, APC, Inc., Ankeny, IA.

Summary and Implications

- Dietary bovine spray-dried plasma protein (SDPP) had no effects on growth performance or breast-meat yield of broilers raised in a low-antigen environment (Exp. 1).
- Dietary bovine SDPP, fed at intermediate levels throughout the growth period, improved growth performance and breast-meat yield of broilers raised in a high-antigen environment (Exp. 2).
- Further research is needed to determine the optimal inclusion level of bovine SDPP and to determine if SDPP should be fed throughout the growth period or in early growth phases only.

Introduction

Commercial broiler chickens are raised in floor pens and the litter commonly reused between flocks. This management practice has economic benefits, but exposes the chickens to bacteria and parasites in the litter from the previous flock, in turn creating an 'antigenic environment' in which growth performance may be reduced.

The beneficial effects of dietary spray-dried plasma protein (SDPP) on the growth performance of weanling pigs raised in unsanitary environments are well documented. In contrast, only little information is available on the effects of dietary SDPP on the growth performance of broilers. The objectives of this study were therefore to determine the growth performance and breast-meat yield responses of broiler chickens to graded levels of dietary bovine SDPP when raised in an antigenic environment simulating common production practices.

Materials and Methods

The study was performed at the Iowa State University Poultry Science Research Center between October, 2003, and January, 2004. In Exp. 1, the antigenic environment was created by mixing 50% clean pine shavings with 50% soiled litter from an on-site turkey barn. The litter was reused in the otherwise identical Exp. 2, performed 2 weeks after the conclusion of Exp. 1. During the 2-week down period, the building remained heated (min. 15°C), while the litter was kept moist to facilitate bacterial growth and blended with an additional 25% soiled turkey litter.

In each experiment, 480 unvaccinated 1-day-old male broiler chicks (Ross × Ross 308) were randomly allotted to 40 floor pens (1.5 m^2, 12 chicks per pen) according to a randomized complete block design. The treatments consisted of graded levels of dietary bovine SDPP (AP920; APC, Inc., Ankeny, IA), which replaced soybean meal on a lysine basis (Table 1). Portions of the animal–vegetable fat and all of the bovine SDPP were sprayed on the diets after pelleting and all diets were formulated to meet or exceed the National Research Council's nutrient recommendations.

The pen average daily body weight gain, feed consumption, and feed utilization were evaluated weekly. On day 41 of age, individual body weights were recorded, after which feed was withdrawn overnight. The following morning (at 6 weeks of age), all broilers were processed in pen order at the Iowa State University Meat Laboratory and the dressing percentage and percent breast meat determined.

Data were analyzed by ANOVA appropriate for a randomized complete block design with the pens' location within the barn as blocking criterion. Effects of bovine SDPP were evaluated using linear, quadratic, and cubic contrasts with $P < 0.05$ considered significant.

Results and Discussion

In the low-antigen environment (Exp. 1), dietary bovine SDPP did not affect growth performance in the Starter Phase, but increased feed consumption in the Grower Phase, leading to a lower feed utilization (Table 2). The overall growth performance and carcass composition were not affected by the dietary treatments.

Antibodies in the bovine SDPP were expected to compensate for the immature status of the gut-associated lymphoid tissue (GALT) and to protect against pathogens, which may lead to a suppressed feed consumption and growth rate. This effect was not observed, and Exp. 1 was therefore repeated with the anticipation that reusing the soiled litter would result in a high-antigen environment in which the bovine SDPP would more clearly exert its effects. Indeed, the average daily body weight gain of the control-fed broilers (Diet A) observed in Exp. 2 was lower than that observed in Exp. 1 and their body weights were less uniform (data not shown). In addition, the mortality of control-fed broilers in Exp. 2 was higher than that observed in Exp. 1 (data not shown). These observations suggest that the reuse of the litter and the lack of cleaning and disinfection of the barn between the experiments resulted in a relatively more antigenic environment in Exp. 2.

In the high-antigen environment of Exp. 2, dietary bovine SDPP increased feed consumption in all growth phases and increased the body weight gain in both the Grower and Overall Phases. In addition, dietary bovine SDPP improved feed utilization in the Starter and Grower Phases (Table 2).

The higher body weight gain of SDPP-fed broilers in Exp. 2 resulted in heavier birds at slaughter, but no effects of SDPP were observed in carcass weights or dressing percentages (Table 3). However, breast-meat yield increased by half a percentage point when bovine SDPP was fed (Figure 1). Thus, dietary bovine SDPP improved growth performance and breast-meat yield of broiler chickens when raised in a high-antigen environment.

Table 1. Percentage composition and calculated analysis of the dietary treatments, A, B, C, D, and E.

Item	Starter Phase (0–2 wk of age)					Grower Phase (2–4 wk of age)					Finisher Phase (4–6 wk of age)				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Ingredient															
SDPP[1]	0.00	0.50	1.00	1.50	2.00	0.00	0.25	0.50	0.75	1.00	0.00	0.13	0.25	0.38	0.50
Soybean meal	37.50	36.37	35.23	34.07	32.93	33.90	33.33	32.77	32.20	31.63	28.30	28.00	27.73	27.43	27.17
Corn	54.27	55.14	56.01	56.92	57.79	56.76	57.19	57.63	58.07	58.50	62.98	63.21	63.41	63.65	63.84
A.V. fat blend	3.83	3.60	3.37	3.13	2.90	5.13	5.02	4.90	4.78	4.67	4.89	4.83	4.78	4.71	4.66
Other[2]	4.40	4.39	4.39	4.38	4.38	4.21	4.21	4.20	4.20	4.20	3.83	3.83	3.83	3.83	3.83
Calculated analysis															
Met+Cys, %	0.90	0.90	0.90	0.90	0.90	0.83	0.83	0.83	0.83	0.83	0.72	0.72	0.72	0.72	0.72
Lys, %	1.25	1.25	1.25	1.25	1.25	1.15	1.15	1.15	1.15	1.15	1.00	1.00	1.00	1.00	1.00
ME_n, Mcal/kg	3.05	3.05	3.05	3.05	3.05	3.15	3.15	3.15	3.15	3.15	3.20	3.20	3.20	3.20	3.20

[1]Spray-dried plasma protein, bovine origin (AP920; APC, Inc., Ankeny, IA).
[2]Limestone, dicalcium phosphate, salt, vitamin and mineral premixes, DL-methionine, monensin-Na (90 g per 907 kg diet).

Table 2. Growth performance.

Growth phase	Treatment[1]	Experiment 1			Experiment 2		
		Body weight gain (g/d)	Feed consumption (g/d)	Feed utilization (g gain/kg feed)	Body weight gain (g/d)	Feed consumption (g/d)	Feed utilization (g gain/kg feed)
Starter	A	29.3	36.5	802	27.8	38.1	729
	B	28.2	35.8	787	28.3	38.8	731
	C	29.0	36.7	790	27.1	38.8	699
	D	29.1	36.7	795	28.3	38.6	733
	E	28.7	35.8	799	27.7	36.3	765
	Standard error	0.5	0.5	9	0.3	0.7	14
	Significance[2]	NS	NS	NS	NS	Q	Q
Grower	A	84.8	119.0	713	75.2	112.8	667
	B	83.7	117.4	713	78.2	114.3	684
	C	85.3	121.3	703	76.8	113.5	677
	D	83.8	120.8	694	80.1	116.1	690
	E	83.1	116.8	711	76.5	111.0	690
	Standard error	0.8	1.0	4	1.1	1.3	5
	Significance[2]	NS	Q, C	Q, C	Q	Q	L
Finisher	A	104.6	175.6	595	101.9	170.8	597
	B	104.8	175.0	599	103.1	176.0	586
	C	105.5	175.1	603	103.8	175.0	593
	D	104.8	174.6	600	104.0	176.9	588
	E	104.5	176.2	593	100.7	171.8	586
	Standard error	1.7	1.9	7	1.6	2.1	7
	Significance[2]	NS	NS	NS	NS	Q	NS

Continues

Table 2. Growth performance (continued).

Growth phase	Treatment	Experiment 1			Experiment 2		
		Body weight gain (g/d)	Feed consumption (g/d)	Feed utilization (g gain/kg feed)	Body weight gain (g/d)	Feed consumption (g/d)	Feed utilization (g gain/kg feed)
Overall	A	72.1	110.0	656	67.5	105.3	641
	B	71.4	108.4	659	69.1	107.4	644
	C	72.5	110.5	656	68.4	108.2	632
	D	71.8	110.3	651	70.0	108.9	643
	E	71.3	108.6	656	67.5	103.8	651
	Standard error	0.7	0.9	4	0.7	1.2	6
	Significance[2]	NS	C	NS	Q	Q	NS

[1]The dietary treatments are described in Table 1.
[2]NS, not significant ($P > 0.05$); L, linear effect ($P < 0.05$); Q, quadratic effect ($P < 0.05$).

Table 3. Carcass composition after 6 weeks of feeding bovine SDPP (Exp. 2).

Treatment[1]	Live weight at slaughter (kg)	Carcass weight (kg)	Dressing percentage	Carcass composition[2] (% of carcass weight)		
				Leg	Wing	Remainder of carcass[3]
A	2.80	2.01	71.4	29.6	10.5	24.8
B	2.87	2.04	71.2	29.6	10.6	24.8
C	2.84	2.03	71.4	29.1	10.5	24.6
D	2.90	2.07	71.2	29.3	10.5	24.5
E	2.80	1.99	71.1	29.5	10.2	24.7
Standard error	0.03	0.02	0.3	0.2	0.1	0.2
Significance[4]	Q	Q	NS	NS	L	NS

[1]The dietary treatments are described in Table 1.
[2]Skin-on, bone-in.
[3]Carcass less legs, wings, and breast.
[4]NS, not significant ($P > 0.05$); L, linear effect ($P < 0.05$); Q, quadratic effect ($P < 0.05$).

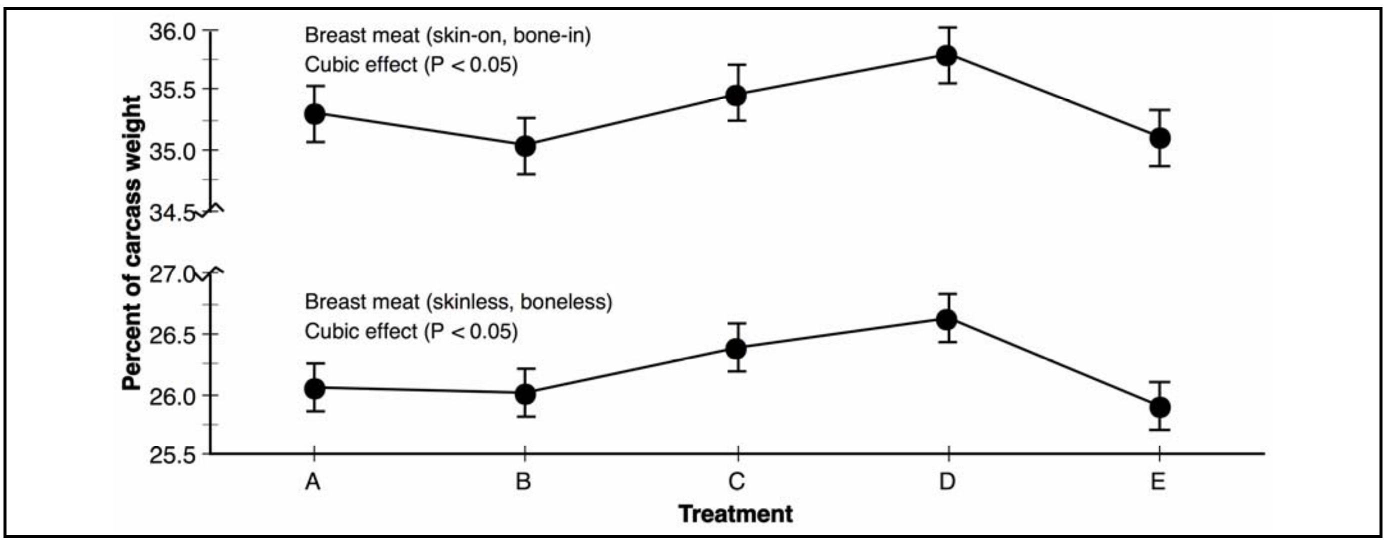

Figure 1. Breast-meat yield after 6 weeks of feeding bovine SDPP (Exp. 2). Dots (•) are means ± standard error of 8 pens, each containing 12 chickens. The dietary treatments (A, B, C, D, and E) are described in Table 1.