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Cobb MV × Cobb 700 broiler responses to eight varying levels of amino acid density with emphasis on digestible lysine

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Primary Audience: Nutritionists, Processing Plant Managers, Primary Breeder Geneticists

SUMMARY

The percentage of broiler complex processing plants slaughtering big birds (e.g., those greater than 3.5 kg) has steadily increased in the United States the past 15 yr. Precision amino acids in dietary formulation is key as the growing cycle for these birds is extended, as well as total feed consumed. Furthermore, broilers reared for big-bird slaughter plants are destined for specialty breast meat yield portioning, making digestible Lys one of the key nutrients in feed formulation. This work assesses dietary Lys levels in graduations across feed phases to 53 D in Cobb MV × Cobb 700 female and male broilers. Optimizing digestible Lys in the starter phase (to 14 D) occurred between 1.26 and 1.31%. On average, dietary Lys intake per bird needed to optimize live performance, and white meat yield was higher in male birds (64 g) than in female birds (58 g). Optimization of Lys amino acid density in the Cobb MV × Cobb 700 broilers resulted in increased white meat yields in larger broilers, resulting in increased fillet weights per bird with white striping and woody breast being unaffected.

Key words: broiler, lysine, protein, Cobb 700

2020 J. Appl. Poult. Res. 29:34–47
https://doi.org/10.1016/j.japr.2019.12.002

DESCRIPTION OF PROBLEM

Many approaches have been used to establish the requirements of digestible Lys and other nutrients of broilers. Previous work has estimated different requirements based on genotype and phenotype [1]. The Cobb MV × Cobb 700 broiler is a commercial high-yielding late-maturing broiler that is designed for increased breast yield as a percentage of live BW. Previous studies have explored the Cobb 700 on different male crosses; however, the Cobb MV × Cobb 700 broiler cross has not been evaluated for its sensitivity to digestible Lys, which is a key nutrient for skeletal muscle formation, which in turn makes digestible Lys a key nutrient for a high-yielding broiler breeder [2].

The National Research Council's most recent Lys recommendation for a broiler chicken from 0 to 3 wk of age is 1.10% total, from 3 to 6 wk is 1.00% total, and from 6 to 8 wk of age is 0.85% total [3]. If these total lysine levels are met by a corn-soybean meal–based diet which has approximately 88% digestible Lys, the requirements of digestible Lys for 0 to 3 wks would

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Table 1. Experimentation diet compositions[1] by treatment[2] (T) with increasing digestible lysine fed to Cobb MV × Cobb 700 broilers 0 to 14 D, 14 to 28 D, 28 to 41 D, and 41 to 53 D of age (experiment 1 and 2).[5,6]

	Treatments							
	T1	T2	T3	T4[3]	T5[4]	T6	T7	T8
0–14 D								
Digestible Lys, %	0.90	0.98	1.06	1.14	1.22	1.30	1.38	1.46
Corn	73.91	70.07	66.23	62.39	58.55	54.26	50.59	46.31
Soybean meal, 48%	21.52	24.67	27.82	30.97	34.11	37.65	40.67	44.20
Dicalcium phosphate	1.90	1.87	1.85	1.83	1.81	1.79	1.77	1.74
Limestone	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.86
Poultry fat	0.52	1.20	1.88	2.56	3.24	4.00	4.65	5.40
Salt	0.37	0.37	0.38	0.38	0.38	0.38	0.39	0.39
Sodium bicarbonate	0.16	0.16	0.15	0.15	0.14	0.14	0.14	0.13
L-Lysine HCl, 78.8%	0.18	0.18	0.18	0.19	0.19	0.19	0.18	0.18
DL-Methionine	0.16	0.19	0.23	0.27	0.31	0.34	0.38	0.41
L-Threonine	0.07	0.08	0.09	0.11	0.12	0.13	0.14	0.15
Selenium premix	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
14–28 D								
Digestible Lys, %	0.76	0.84	0.92	1.00	1.08	1.16	1.24	1.32
Corn	76.15	73.01	69.88	66.75	63.62	59.29	55.59	51.27
Soybean meal, 48%	18.76	21.27	23.78	26.29	28.80	32.37	35.42	38.98
Dicalcium phosphate	1.92	1.90	1.88	1.87	1.85	1.83	1.81	1.78
Limestone	1.03	1.02	1.00	0.98	0.97	0.95	0.93	0.91
Poultry fat	1.22	1.79	2.36	2.93	3.49	4.26	4.91	5.67
Salt	0.37	0.37	0.37	0.38	0.38	0.38	0.38	0.39
Sodium bicarbonate	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14
L-Lysine HCl, 78.8%	0.09	0.11	0.14	0.16	0.18	0.18	0.17	0.17
DL-Methionine	0.08	0.13	0.17	0.21	0.26	0.29	0.33	0.36
L-Threonine	0.01	0.03	0.06	0.08	0.10	0.11	0.12	0.13
28–41 D								
Digestible Lys, %	0.66	0.74	0.82	0.90	0.98	1.06	1.14	1.22
Corn	66.99	66.60	66.21	65.82	65.42	61.28	57.73	53.59
Soybean meal, 48%	15.69	18.31	20.93	23.55	26.16	29.56	32.48	35.88
Wheat shorts	10.00	7.50	5.00	2.50	-	-	-	-
Dicalcium phosphate	1.73	1.77	1.80	1.84	1.87	1.85	1.83	1.81
Limestone	1.15	1.11	1.07	1.02	0.98	0.96	0.94	0.92
Poultry fat	3.64	3.82	4.01	4.19	4.38	5.11	5.74	6.48
Salt	0.37	0.37	0.37	0.38	0.38	0.38	0.38	0.39
Sodium bicarbonate	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.14
L-Lysine HCl, 78.8%	0.02	0.05	0.08	0.11	0.14	0.14	0.14	0.14
DL-Methionine	0.06	0.11	0.15	0.19	0.23	0.28	0.31	0.35
L-Threonine	-	0.02	0.03	0.05	0.07	0.08	0.09	0.11
41–53 D								
Digestible Lys, %	0.61	0.69	0.77	0.85	0.93	1.01	1.09	1.17
Corn	57.27	59.78	62.29	64.79	67.30	63.16	59.60	55.46
Soybean meal, 48%	11.69	14.82	17.95	21.08	24.21	27.61	30.52	33.92
Wheat shorts	20.00	15.00	10.00	5.00	-	-	-	-
DDGS	2.34	1.76	1.17	0.59	-	-	-	-
Dicalcium phosphate	1.51	1.61	1.70	1.80	1.89	1.87	1.85	1.82
Limestone	1.28	1.21	1.14	1.07	0.99	0.97	0.95	0.93
Poultry fat	5.18	4.99	4.80	4.62	4.43	5.16	5.79	6.53
Salt	0.36	0.36	0.37	0.37	0.38	0.38	0.38	0.38
Sodium bicarbonate	0.10	0.11	0.13	0.14	0.16	0.15	0.15	0.14

continued

Table 1. Continued

	Treatments							
	T1	T2	T3	T4[3]	T5[4]	T6	T7	T8
L-Lysine HCl, 78.8%	0.02	0.05	0.08	0.11	0.14	0.14	0.14	0.14
DL-Methionine	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33
L-Threonine	-	0.02	0.05	0.07	0.09	0.11	0.12	0.14

Abbreviation: DDGS, distillers dried grains with solubles.

[1]All diets contained choline = 0.05%, vitamin premix@ = 0.05% and mineral premixˆ = 0.10%.

[2]Diets for T1, T5 and T8 were mixed accordingly. T2 diets were a blend of 75% of T1 diets and 25% of T5 diets. T3 diets were a blend of 50% of T1 diets and 50% of T5 diet. T4 diets were a blend of 25% of T1 diets and 75% of T5 diets. T6 diets were a blend of 66.7% of T5 diets and 33.3% of T8 diets. T7 diets were a blend of 66.7% of T5 and 33.3% of T8 diets.

[3]Treatment 4 diets are similar to NRC recommendations for digestible lysine as a percentage of diet by age.

[4]Treatment 5 diets are equivalent to Cobb-Vantress, Inc. recommendations for the Cobb MV × Cobb 700 broiler.

[5]Mineral premix contained per kilogram of all diets (minimum): Ca, 48.8 mg; Mn, 80 mg; Mg, 21.6 mg; Zn, 80 mg; Fe, 40 mg; Cu, 8 mg; I, 0.8 mg.

[6]Vitamin premix contained per kilogram of all diets (minimum): vitamin A, 30,837,000 IU; vitamin D_3, 22,026,432 ICU; vitamin E, 22,026 IU; vitamin B_{12}, 53 mg; menadione, 6,000 mg; riboflavin, 26,432 mg; d-pantothenic acid, 39,648 mg; thiamine, 6,167 mg; niacin, 154,185 mg; pyridoxine, 11,013 mg; folic acid, 3,524 mg; biotin, 330 mg.

be 0.97% digestible Lys, 3 to 6 wk would be 0.88% digestible Lys, and for 6 to 8 wk of age 0.75% digestible Lys [3, 4]. The Cobb 700 Broiler Performance and Nutrition Supplement suggests that the need for digestible Lys of the Cobb 700 broiler is 1.22% in the starter phase (0–10 D), 1.08% in the grower phase (11–22 D), 0.99% in the first finisher phase (23–42 D), and 0.95% in the second finisher phase (43 D to end) [5]. The difference between these 2 recommendations is attributed to changes in breeds since the latest NRC recommendations, and breast yield was not of high importance before the 1994 recommendations. Many of the broiler breeds used in published research chosen to set the NRC recommendations are no longer commercially available. In previous work using high-yielding, late-maturing broilers (i.e., Ross × Ross 708), the digestible Lys requirement for female birds in the starter phase (1–15 D) was estimated to be 1.27% for BW gain [6]. Since the former work, the male breeder for the Ross 708 has changed to a Ross RY + male, which may necessitate more digestible Lys for performance optimization. The digestible Lys need of 1- to 15-D-old Hubbard × Cobb 500 female broilers for BW gain and feed conversion ratio (**FCR**) was estimated to be 1.18 and 1.26%, respectively [6]. In 2 experiments with Cobb 500 male by-product broilers, the 0- to 21-D need of digestible Lys for BW gain was found to be 1.00 and 0.99%, and the need for digestible Lys for FCR was 1.10 and 0.94% [7]. However, the Cobb 500 male by-product line is a two-way genetic standard parent male bird and is not representative of the high-yielding, late-maturing, four-way genetic broiler cross of the Cobb MV × Cobb 700 broiler. The requirements of each breed and breed cross are different and continually changing with genetic progress of increased whole-body protein and decreased whole body fat [6, 7]. Moreover, there is no published data for the Cobb MV × Cobb 700 dietary needs for Lys. The purpose of these experiments was to evaluate live production and processing yield responses to 8 increasing digestible Lys levels in diets to measure the optimal amino acid density needed for the Cobb MV × Cobb 700 male and female broilers.

MATERIALS AND METHODS

Bird Husbandry

Two experiments—the first consisting of female birds only, the second of male birds only—were conducted concurrently within the same facility to measure live performance and processing characteristics of Cobb MV × Cobb 700 broilers. These experiments were approved by the University of Arkansas Institutional Animal Care and Use Committee protocol 19,001. Twenty-three hundred eggs were obtained from a 55-week-old broiler breeder flock and incubated at the University of Arkansas Agricultural Experimental Station Hatchery

Table 2. Nutrients of isocaloric diets[1] with increasing % digestible lysine by treatment[2] (T) fed from 0 to 14 D, 14 to 28 D, 28 to 41 D, and 41 to 53 D to Cobb MV × Cobb 700 female (experiment 1) and male (experiment 2) broilers.

	Treatments							
	T1	T2	T3	T4[3]	T5[4]	T6	T7	T8
0–14 D (ME = 3,040 kcal/kg)								
CP, %	16.6	17.8	19.0	20.2	21.4	22.8	23.9	25.3
Choline (mg/kg)	1,741	1,787	1,833	1,879	1,925	1,977	2,022	2,073
Potassium, %	0.65	0.70	0.75	0.80	0.85	0.91	0.96	1.01
Linoleic acid, %	1.60	1.69	1.78	1.87	1.96	2.06	2.14	2.24
Digestible TSAA, %	0.67	0.73	0.78	0.84	0.90	0.96	1.02	1.08
Digestible Met, %	0.41	0.46	0.51	0.56	0.61	0.66	0.70	0.75
Digestible Lys, %	0.90	0.98	1.06	1.14	1.22	1.30	1.38	1.46
Digestible Trp, %	0.18	0.19	0.21	0.23	0.24	0.26	0.28	0.30
Digestible Thr, %	0.59	0.64	0.69	0.74	0.79	0.85	0.89	0.95
Digestible Ile, %	0.64	0.69	0.75	0.80	0.86	0.92	0.97	1.03
Digestible Val, %	0.72	0.77	0.82	0.87	0.93	0.99	1.04	1.10
Digestible Arg, %	0.95	1.03	1.11	1.20	1.28	1.38	1.46	1.55
14–28 D (ME = 3,108 kcal/kg)[4]								
CP, %	15.3	16.3	17.3	18.3	19.3	20.6	21.8	23.1
Choline (mg/kg)	1,689	1,725	1,761	1,796	1,832	1,885	1,930	1,982
Potassium, %	0.60	0.64	0.68	0.72	0.76	0.82	0.86	0.92
Linoleic acid, %	1.79	1.87	1.94	2.02	2.09	2.19	2.28	2.38
Digestible TSAA, %	0.57	0.63	0.69	0.75	0.81	0.87	0.93	0.99
Digestible Met, %	0.32	0.37	0.43	0.48	0.53	0.58	0.63	0.68
Digestible Lys, %	0.76	0.84	0.92	1.00	1.08	1.16	1.24	1.32
Digestible Trp, %	0.16	0.17	0.19	0.20	0.21	0.23	0.25	0.27
Digestible Thr, %	0.49	0.54	0.60	0.65	0.70	0.76	0.80	0.86
Digestible Ile, %	0.58	0.63	0.67	0.72	0.76	0.82	0.88	0.94
Digestible Val, %	0.67	0.71	0.75	0.79	0.83	0.89	0.94	1.00
Digestible Arg, %	0.87	0.94	1.00	1.07	1.13	1.23	1.31	1.41
28–41 D (ME = 3,180 kcal/kg)								
CP, %	14.6	15.5	16.4	17.2	18.1	19.4	20.5	21.8
Choline (mg/kg)	1,544	1,603	1,661	1,720	1,778	1,828	1,870	1,920
Potassium, %	0.60	0.63	0.66	0.68	0.71	0.77	0.81	0.87
Linoleic acid, %	2.14	2.18	2.23	2.27	2.31	2.40	2.49	2.58
Digestible TSAA, %	0.52	0.58	0.64	0.70	0.76	0.83	0.88	0.95
Digestible Met, %	0.29	0.34	0.40	0.45	0.50	0.56	0.60	0.66
Digestible Lys, %	0.66	0.74	0.82	0.90	0.98	1.06	1.14	1.22
Digestible Trp, %	0.15	0.16	0.18	0.19	0.20	0.22	0.23	0.25
Digestible Thr, %	0.45	0.50	0.55	0.59	0.64	0.69	0.74	0.79
Digestible Ile, %	0.55	0.59	0.63	0.67	0.71	0.77	0.82	0.88
Digestible Val, %	0.63	0.67	0.71	0.75	0.79	0.85	0.89	0.95
Digestible Arg, %	0.82	0.88	0.94	1.00	1.06	1.15	1.23	1.32
42–53 D (ME = 3,203 kcal/kg)								
CP, %	14.1	14.9	15.7	16.5	17.3	18.6	19.8	21.1
Choline (mg/kg)	1,447	1,521	1,596	1,670	1,744	1,794	1,836	1,886
Potassium, %	0.60	0.62	0.64	0.66	0.68	0.74	0.78	0.84
Linoleic acid, %	2.33	2.34	2.34	2.35	2.35	2.44	2.53	2.62
Digestible TSAA, %	0.48	0.54	0.61	0.67	0.73	0.79	0.85	0.91
Digestible Met, %	0.26	0.31	0.37	0.42	0.47	0.52	0.57	0.62
Digestible Lys, %	0.61	0.69	0.77	0.85	0.93	1.01	1.09	1.17
Digestible Trp, %	0.15	0.16	0.17	0.18	0.19	0.21	0.22	0.24
Digestible Thr, %	0.42	0.47	0.53	0.58	0.63	0.69	0.74	0.80

continued

Table 2. Continued

	Treatments							
	T1	T2	T3	T4[3]	T5[4]	T6	T7	T8
Digestible Ile, %	0.52	0.56	0.60	0.63	0.67	0.73	0.78	0.84
Digestible Val, %	0.60	0.64	0.68	0.71	0.75	0.81	0.85	0.91
Digestible Arg, %	0.76	0.82	0.88	0.94	1.00	1.09	1.17	1.26

[1]All diets contained–calcium 0.90%, available phosphorus 0.45%, sodium 0.21%, chloride 0.28%.

[2]Diets for T1, T5 and T8 were mixed accordingly. T2 diets were a blend of 75% of T1 diets and 25% of T5 diets. T3 diets were a blend of 50% of T1 diets and 50% of T5 diet. T4 diets were a blend of 25% of T1 diets and 75% of T5 diets. T6 diets were a blend of 66.7% of T5 diets and 33.3% of T8 diets. T7 diets were a blend of 66.7% of T5 and 33.3% of T8 diets.

[3]Treatment 4 diets are similar to NRC recommendations for digestible lysine as a percentage of diet by age.

[4]Treatment 5 diets are equivalent to Cobb-Vantress, Inc. recommendations for the Cobb MVM × Cobb 700 broiler.

(Fayetteville, Arkansas). At hatch, chicks were identified by gender through cloaca examination, transferred to an experimental floor pen facility, and placed in floor pens with reused pine shavings (48 pens of male birds and 48 pens of female birds for 2 separate experiments). Each pen measuring 1.83 × 1.07 m contained 18 chicks and was equipped with a 14.5-kg capacity hanging feeder and a nipple drinker line (3.6 birds per nipple). Radiant tube-gas heating was used in addition to minimum ventilation for brooding and air exchange, respectively. All 4 corners of the experimental facility contained exhaust fans, and air entry for cooling was achieved by vent doors positioned along the facility lengthwise. Chicks were exposed to continuous photoperiod (24L:0D) from placement to 3 D, 20:4D photoperiod from 4 to 7 D and then maintained on 19L:5D photoperiod onward.

Dietary Treatments

All diets were formulated to meet or exceed all nutrient needs except for digestible Lys and other amino acids because of these amino acids being formulated as a percent of digestible Lys [5]. Dietary treatments represented graduations in digestible Lys and were fed *ad libitum* from placement to 53 D in phases: 0 to 14 D, 14 to 28 D, 28 to 41 D, and 41 to 53 D of age in both the male and female experiments. Within each growth phase, isocaloric diets were formulated with corn and soybean meal, and digestible Lys reductions were achieved by allowing CP to be reduced (Table 1). Essential amino acid ratios to Lys were maintained per phase (Table 2) in the corn and soybean meal blends by allowing L-Lys HCl and L-Thr to enter formulation. Digestible Lys levels by phase were 0 to 14 D, 0.90 to 1.46% digestible Lys in 0.08% increments; 14 to 28 D, 0.76 to 1.32% digestible Lys in 0.08% increments; 28 to 41 D, 0.66 to 1.22% digestible Lys in 0.08% increments; and 41 to 53 D 0.61 to 1.17% digestible Lys in 0.08% increments. The 8 graded levels of ascending digestible Lys are presented as T1 through T8 in their respectively phases, with T5 representing the Cobb 700 standard. T1, T5, and T8 were the basal diets; T2, T3, T4 were blended using T1 and T5; and T6 and T7 were blended using T5 and T8. Each diet was sampled in the feed mill and analyzed for CP and total Lys. Male and female birds received the same experimental diets.

Parameters Measured

In both experiments, chicks were weighed by pen at days 0, 14, 28, 41, and 53. Feed disappearance was measured from 0 to 14, 14 to 28, 28 to 41, and 41 to 53 D of age. The pens were checked for mortality twice daily, and broilers that died were weighed. The weight of dead birds was subtracted from pen BW in calculating feed-to-BW gain ratio. Live performance (BW gain, feed to gain, mortality, and digestible Lys intake) was assessed from the 0- to 14-D phase, the 0- to 41-D phase, and the 0- to 53-D phase. In the 0- to 14-D phase, a dietary Lys requirement was estimated. The 0- to 41- and 0- to 53-D phases represent Lys amino acid density responses in tray-pack and big bird debone markets, respectively.

On day 53 in both experiments, pen BW was used to calculate pen mean and SD, and 6 birds

Table 3. Cobb MV x Cobb 700 male and female broilers estimated need of digestible lysine as a percentage of diet fed 0 to 14 D for body weight gain and adjusted feed conversion for mortality (FCR) when fed eight separate diets of equal distant increasing digestible lysine diets using two-slope linear broken-line regression estimation[1].

	Two-slope linear broken-line regression estimates							
	Intercept 1	Slope 1	Intercept 2	Slope 2	Digestible lys need[2], %	Estimated response	Lower 95% confidence	Upper 95% confidence
Female								
0–14 D BW gain, g	19.814	241.258	246.561	66.838	1.30	333.50	292.98	357.89
FCR 0–14 D	1.700	−0.441	1.287	−0.123	1.30	1.1269	0.9736	1.2801
Male								
0–14 D BW gain, g	37.6463	243.791	379.318	−28.213	1.26	343.88	314.07	373.69
FCR 0 to 14 D	1.6402	−0.394	0.703	0.3247	1.31	1.1264	1.005	1.2478

[1]Two-slope linear broken-line polynomial formula = IF (intercept1 - intercept2)/(slope2 - slope1) > digestible lysine, %, then (intercept1 + slope1) × digestible lysine %; OR, intercept2 + slope2 × digestible lysine %.

[2]JMP nonlinear curve with the two-slope linear broken-line model estimation curve profiling tool was used to determine the optimal level of digestible lysine for the response. The profiling tool optimal levels was set for maximum desirability to digestible lysine for BW gain and minimum desirability for adjusted feed conversion for mortality.

were randomly selected for processing, and wing band tagged with individual numbers. Birds selected for processing were held with feed withdraw overnight before processing. On day 54, the 6 birds per pen selected for processing were reweighed for BW after a 9-h feed withdrawal period. In both experiments, processing was conducted in a pilot processing plant. Birds were euthanized after stunning by severing of the jugular vein, then scalded before feather picking. After the birds exited the feather picker, all subsequent processing (e.g., hock removal, evisceration, and lung removal) was carried out manually. Carcasses were not placed in ice water and were deboned with no chilling after evisceration manually on cones. Yield percentages were calculated as percentages of live BW by bird, and then the average of the yield percentage of 6 birds per pen was used as the statistical experimental unit. White striping and woody breast scores were measured by trained individuals within Dr. Casey Owens laboratory by palpation of the hot deboned, breast fillet and scored on the following 0 to 3 scale: 0.0 = no incidence, 0.5 = slight incidence, 1.0 = low incidence, 1.5 = mild incidence, 2.0 = moderate incidence, and 3.0 = severe incidence. The procedures for scoring white striping and woody breast scores have previously been described by Tijare et al. and Kuttappan et al. [8, 9].

Animal Welfare

The birds were reared under normal industry conditions, and all daily animal care expectations and welfare outcomes were compliant with the animal welfare standards required by Cobb-Vantress, Inc. The Cobb-Vantress, Inc. animal welfare standards meet or exceed the standards and recommendations of the National Chicken Council for broiler chickens and breeding chickens. Professional Animal Auditor Certification Organization certified auditors routinely conducted welfare audits at each study location to verify compliance with animal welfare standards and company expectations. Audits included a review of the poultry facilities, bird-handling procedures, record keeping of daily bird care, and training records for biosecurity and animal welfare. All employees at Cobb-

Table 4. Cobb MV × Cobb 700 quadratic polynomial[1] estimation curves and estimated need of digestible lysine intake[2] for body weight gain, adjusted feed conversion ratio for mortality (FCR) and white breast meat, responses to total digestible lysine intake for ages 0 to 14 D, 0 to 41 D, and 0 to 53 D.

Quadratic estimation curves for BW gain (g), FCR and white meat yield (g)											
	Intercept	Slope	Quadratic	Digestible lys intake need, (g)	Estimated response	Lower 95%[3]	Upper 95%[3]	R square	*P* value intercept	*P* value slope	*P* value quadratic
Female											
BW gain											
0–14 D	38.27	72.09	−3.56	5.60	331	332	338	0.7711	0.5968	0.0196	0.2643
0–41 D	−338.58	105.63	−1.05	37.35	2,137	2,107	2,167	0.9365	0.0831	<0.0001	<0.0001
0–53 D	−43.12	84.69	−0.56	57.27	2,969	2,923	3,014	0.8930	0.8898	<0.0001	<0.0001
FCR											
0–14 D	1.312	0.004	−0.006	6.78	1.070	0.978	1.162	0.2639	<0.0001	0.9732	0.6643
0–41 D	2.597	−0.037	0.0003	37.38	1.639	1.622	1.655	0.9151	<0.0001	<0.0001	0.0044
0–53 D	2.743	−0.021	−0.000	55.58	1.849	1.820	1.878	0.7825	<0.0001	0.0077	0.2460
White meat 54 D	−115.4	22.440	−0.087	60.06	918	900	937	0.9175	0.3529	<0.0001	0.0965
Male											
BW gain											
0–14 D	−59.44	118.65	−8.58	5.38	331	322	339	0.7165	0.3704	<0.0001	0.0010
0–41 D	−983.13	131.72	−1.18	39.90	2,395	2,342	2,448	0.9303	0.0005	<0.0001	<0.0001
0–53 D	−583.10	98.73	−0.56	63.13	3,437	3,372	3,503	0.9162	0.1231	<0.0001	<0.0001
FCR											
0–14 D	1.895	−0.245	0.204	5.07	1.175	1.148	1.201	0.3398	<0.0001	0.0026	0.0106
0–41 D	2.738	−0.041	0.000	42.02	1.608	1.580	1.635	0.8435	<0.0001	<0.0001	0.0074
0–53 D	2.952	−0.026	0.006	64.18	1.796	1.769	1.823	0.8634	<0.0001	<0.0001	0.0132
White meat 54 D	−495.5	33.3	−0.16	65.03	993	969	1,018	0.9247	0.0008	<0.0001	0.0013

[1]Quadratic polynomial estimation curve = intercept ± slope × digestible lysine intake ± quadratic × digestible lysine intake.[2]

[2]JMP fit curve, quadratic response curve profiler desirability set at a level of 2 (higher order) for the live production response of interest.

[3]Upper and lower confidence limits at 95%.

Table 5. Cobb MV × Cobb 700 female and male broilers BW gain, adjusted feed conversion ratio for mortality (FCR), and digestible lysine intake by treatments[1] (T) with different levels of dietary digestible lysine (% of diet) by ages 0 to 14 D, 0 to 41 D, 0 to 53 D of age.

	Treatments with increasing digestible lysine									
	T1	T2	T3	T4	T5	T6	T7	T8	SEM	P value[2]
Female performance										
BW gain, g										
0−14 D	247^{d}	249^{d}	268^{c,d}	295^{b,c}	317^{a,b}	349^{a}	329^{a}	349^{a}	9.2	<0.0001
0−41 D	1,412^{d}	1,666^{c}	1,884^{b,c}	2,084^{a,b}	2,179^{a}	2,158^{a}	2,196^{a}	2,277^{a}	53.6	<0.0001
0−53 D	2,041^{d}	2,376^{c,d}	2,688^{b,c}	2,887^{a,b}	2,955^{a,b}	2,956^{a,b}	3,022^{a,b}	3,043^{a}	73.9	<0.0001
FCR										
0−14 D	1.285^{a}	1.285^{a}	1.218^{a,b}	1.226^{a,b}	1.176^{a,b}	1.087^{b}	1.121^{b}	1.106^{b}	0.0345	<0.0001
0−41 D	1.982^{a}	1.843^{b}	1.766^{b,c}	1.696^{c,d}	1.615^{e}	1.623^{c,d}	1.563^{e,f}	1.531^{f}	0.0159	<0.0001
0−53 D	2.203^{a}	2.068^{b}	1.982^{b,c}	1.894^{c,d}	1.825^{d,e}	1.807^{d,e}	1.765^{e}	1.748^{e}	0.0221	<0.0001
Digestible Lys intake, g										
0−14 D	3.4^{f}	3.7^{e,f}	4.0^{e}	4.7^{d}	5.2^{c,d}	5.6^{b,c}	5.8^{b}	6.4^{a}	0.12	<0.0001
0−41 D	20.9^{g}	25.3^{f}	30.0^{e}	34.7^{d}	37.4^{c,d}	40.2^{b,c}	42.1^{b}	45.6^{a}	0.73	<0.0001
0−53 D	31.3^{g}	38.1^{f}	45.5^{e}	51.2^{d}	54.9^{c,d}	58.8^{b,c}	62.9^{a,b}	67.1^{a}	1.23	<0.0001
Male performance										
BW gain, g										
0−14 D	244^{b}	292^{a,b}	298^{a,b}	318^{a}	328^{a}	343^{a}	338^{a}	339^{a}	12.0	<0.0001
0−41 D	1,304^{d}	1,765^{c}	2,102^{b}	2,378^{a,b}	2,527^{a}	2,514^{a}	2,610^{a}	2,639^{a}	67.8	<0.0001
0−53 D	2,091^{c}	2,551^{c}	3,063^{b}	3,352^{a,b}	3,455^{a,b}	3,598^{a}	3,481^{a,b}	3,681^{a}	93.7	<0.0001
FCR										
0−14 D	1.312^{a}	1.208^{a,b}	1.240^{a,b}	1.189^{a,b}	1.166^{b}	1.127^{b}	1.151^{b}	1.177^{b}	0.0266	<0.0001
0−41 D	2.036^{a}	1.876^{b}	1.750^{c}	1.661^{d}	1.602^{d,e}	1.628^{d}	1.519^{e,f}	1.493^{f}	0.0164	<0.0001
0−53 D	2.226^{a}	2.136^{a}	1.909^{b}	1.877^{b}	1.803^{b,c}	1.760^{c,d}	1.711^{c,d}	1.690^{d}	0.0225	<0.0001
Digestible Lys intake, g										
0−14 D	3.4^{g}	4.0^{f,g}	4.6^{e,f}	4.9^{d,e}	5.4^{c,d}	5.7^{b,c}	6.1^{a,b}	6.7^{a}	0.14	<0.0001
0–41 D	22.1^{g}	27.3^{f}	33.1^{e}	38.6^{d}	42.8^{c,d}	46.5^{b,c}	47.2^{a,b}	51.3^{a}	0.92	<0.0001
0–53 D	33.6^{f}	42.1^{e}	49.8^{d}	58.6^{c}	63.1^{b,c}	69.3^{b}	69.9^{b}	78.2^{a}	1.48	<0.0001

$^{a\text{-}g}$Mean values within a row that have different letters are different at $P < 0.05$ (Tukey's test). One male pen in T1 was determined to be an extreme outlier for body weight gain 0 to 41 D and 0 to 53 D of age; therefore, it was removed from analysis.

[1]Treatment percent digestible lysine in diets by age (0 D–14 D, 14 D–28 D, 28 D–41 D and 41 D–53 D) respectively; T1 = 0.90, 0.76, 0.66, 0.61; T2 = 0.98, 0.84, 0.74, 0.69; T3 = 1.06, 0.94, 0.82, 0.76; T4 = 1.14, 1.02, 0.90, 0.84; T5 = 1.22, 1.10, 0.98, 0.92; T6 = 1.30, 1.10, 0.98, 0.92; T7 = 1.38, 1.18, 1.06, 1.00; T8 = 1.46, 1.26, 1.14, 1.08.

[2]P values for 0 to 14 D parameters is in Table 3 with estimated predicted optimal digestible Lys level.

Table 6. Cobb MV × Cobb 700 female and male 54-D broiler live BW and mean processing yields as percentages of live BW when fed diet treatments[1] (T) with different percentage levels of dietary digestible lysine.

	Treatments with increasing % digestible lysine									
	T1	T2	T3	T4	T5	T6	T7	T8	SEM	P value
Females										
Live BW, g	2,484^{c}	2,739^{b,c}	3,041^{a,b}	3,047^{a,b}	3,106^{a}	3,175^{a}	3,247^{a}	3,260^{a}	78.7	<0.0001
Carcass, %	73.5^{e}	74.8^{d,e}	75.6^{c,d}	77.0^{b,c}	77.8^{a,b}	78.5^{a}	78.8^{a}	78.9^{a}	0.31	<0.0001
Fillet, %	16.4^{f}	18.1^{e}	19.9^{d}	21.7^{c}	22.7^{b,c}	23.4^{a,b}	24.8^{a}	25.0^{a}	0.33	<0.0001
Tender, %	3.7^{c}	3.9^{c}	4.4^{b}	4.7^{a,b}	4.8^{a}	4.9^{a}	4.9^{a}	5.0^{a}	0.09	<0.0001
Wings, %	7.5	7.3	7.2	7.2	7.3	7.4	7.2	7.2	0.08	0.3062
Thighs, %	14.6^{a}	14.4^{a,b}	14.2^{a,b,c}	14.1^{a,b,c,d}	13.9^{b,c,d}	13.9^{b,c,d}	13.7^{c,d}	13.5^{d}	0.13	<0.0001
Drums, %	9.3	9.3	9.1	9.0	9.1	9.0	9.0	8.8	0.11	0.1102
Abdominal fat, %	2.2^{a}	1.9^{a,b}	1.7^{a,b,c}	1.5^{b,c,d}	1.4^{b,c,d}	1.3^{c,d}	1.2^{c,d}	1.2^{d}	0.11	<0.0001
Males										
Live BW, g	2,469^{d}	2,971^{c}	3,350^{b,c}	3,570^{a,b}	3,688^{a,b}	3,767^{a,b}	3,697^{a,b}	3,853^{a}	101.7	<0.0001
Carcass, %	71.2^{d}	73.4^{c}	75.1^{b}	76.9^{a}	77.7^{a}	77.7^{a}	78.1^{a}	78.3^{a}	0.33	<0.0001
Fillet, %	14.5^{e}	16.9^{d}	18.9^{c}	21.1^{b}	22.7^{a,b}	23.3^{a}	23.8^{a}	24.1^{a}	0.40	<0.0001
Tender, %	3.2^{d}	3.6^{c}	3.8^{c}	4.2^{b}	4.4^{a,b}	4.4^{a,b}	4.6^{a}	4.5^{a}	0.07	<0.0001
Wings, %	7.5	7.5	7.3	7.4	7.4	7.4	7.5	7.4	0.09	0.7487
Thighs, %	14.5	14.8	14.8	14.6	14.3	14.4	14.4	14.3	0.16	0.2097
Drums, %	10.1	9.8	10.2	9.9	9.7	9.5	9.7	9.7	0.14	0.0654
Abdominal fat, %	1.7^{a}	1.8^{a}	1.5^{a,b}	1.5^{a,b}	1.3^{a,b,c}	1.1^{a,b}	1.0^{b,c}	0.8^{c}	0.11	<0.0001

$^{a\text{-}f}$Mean values within a row that have different letters are different at $P < 0.05$ (Tukey's test).

[1]Treatment percent of digestible lysine in diets by ages fed respectively; T1 = 0.90, 0.76, 0.66, 0.61; T2 = 0.98, 0.84, 0.74, 0.69; T3 = 1.06, 0.94, 0.82, 0.76; T4 = 1.14, 1.02, 0.90, 0.84; T5 = 1.22, 1.10, 0.98, 0.92; T6 = 1.30, 1.10, 0.98, 0.92; T7 = 1.38, 1.18, 1.06, 1.00; T8 = 1.46, 1.26, 1.14, 1.08.

Table 7. Cobb MV × Cobb 700 broilers fed different percent digestible lysine of the diet by treatment (T), mean percent[1] wooden breast and white striping by myopathy scores[2].

	Treatments[3] with increasing percent digestible lysine									
	T1	T2	T3	T4	T5	T6	T7	T8	SEM	*P* value
Females										
White striping, %										
Score 0.0	40.0	43.3	13.3	30.0	23.3	33.3	10.0	10.0	0.09	0.0629
Score 0.5	56.7^{a}	$36.7^{a,b}$	75.0^{a}	$41.7^{a,b}$	$46.7^{a,b}$	$36.7^{a,b}$	$43.3^{a,b}$	29.2^{b}	0.08	0.0336
Score 1.0	3.3^{b}	$20.0^{a,b}$	7.5^{b}	$24.2^{a,b}$	$30.0^{a,b}$	$20.0^{a,b}$	$30.0^{a,b}$	46.7^{a}	0.08	0.0149
Score 2.0	0.0	0.0	4.2	4.2	0.0	6.7	13.3	10.0	0.03	0.1751
Score 3.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3	4.17	0.01	0.6869
Wooden breast, %										
Score 0.0	63.33^{a}	$50.00^{a,b}$	$39.17^{a,b,c}$	$24.17^{a,b,c}$	$26.67^{a,b,c}$	$40.00^{a,b,c}$	$13.33^{b,c}$	3.33^{c}	0.08	0.0007
Score 0.5	33.33	33.33	50.00	61.67	53.33	53.33	50.00	49.17	0.10	0.2625
Score 1.0	3.33	16.67	6.67	10.00	20.00	13.33	10.00	13.33	0.06	0.4366
Score 1.5	0.00	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.4478
Score 2.0	0.00	0.00	4.17	0.00	0.00	10.0	6.67	20.00	0.03	0.0818
Score 3.0	0.00^{b}	0.00^{b}	0.00^{b}	$4.17^{a,b}$	0.00^{b}	$6.67^{a,b}$	16.67^{a}	$14.17^{a,b}$	0.03	0.0049
Males										
White striping, %										
Score 0.0	63.3^{a}	$36.7^{a,b}$	$20.0^{b,c}$	$10.8^{b,c}$	$13.3^{b,c}$	3.3^{c}	$6.7^{b,c}$	$6.7^{b,c}$	0.06	<0.0001
Score 0.5	$33.3^{a,b}$	$43.3^{a,b}$	$47.8^{a,b}$	58.3^{a}	16.7^{b}	$38.3^{a,b}$	$33.3^{a,b}$	$27.5^{a,b}$	0.08	0.0261
Score 1.0	3.3^{d}	$16.7^{c,d}$	$28.9^{a,b,c,d}$	$20.8^{b,c,d}$	60.0^{a}	$34.2^{a,b,c,d}$	$40.0^{a,b,c}$	$54.2^{a,b}$	0.08	0.0002
Score 2.0	0.0	3.3	3.3	10.0	6.7	20.8	16.7	11.7	0.05	0.1140
Score 3.0	0.0	0.0	0.0	0.0	3.3	3.3	3.3	0.0	0.01	0.6912
Wooden breast, %										
Score 0.0	50.0^{a}	$33.3^{a,b}$	$25.6^{a,b}$	10.0^{b}	10.0^{b}	15.0^{b}	$20.0^{a,b}$	3.3^{b}	0.07	0.0004
Score 0.5	23.3	36.7	26.7	50.8	30.0	17.5	26.7	16.7	0.08	0.0943
Score 1.0	23.2	23.2	31.1	17.5	26.7	20.0	20.0	20.0	0.08	0.9621
Score 1.5	0.0	0.0	0.0	0.0	3.3	6.7	0.0	0.0	0.01	0.1590
Score 2.0	3.3	6.7	16.7	21.7	16.7	16.7	10.0	35.0	0.07	0.1317
Score 3.0	0.0^{b}	0.0^{b}	0.0^{b}	0.0^{b}	$13.3^{a,b}$	24.2^{a}	23.3^{a}	25.0^{a}	0.03	0.0002

[a-d]Mean values within a row that have different letters are different at $P < 0.05$ (Tukey's test).

[1]Myopathy percentages were figured as: counts by score/total fillets counted by pen.

[2]Myopathy scores were assigned to the breast fillets as: 0 = no incidence, 0.5 = slight incidence, 1.0 = low incidence, 1.5 = mild incidence, 2.0 = moderate incidence, 3.0 = severe incidence.

[3]Treatment percent digestible lysine in diets by ages fed respectively; T1 = 0.90, 0.76, 0.66, 0.61; T2 = 0.98, 0.84, 0.74, 0.69; T3 = 1.06, 412 0.94, 0.82, 0.76; T4 = 1.14, 1.02, 0.90, 0.84; T5 = 1.22, 1.10, 0.98, 0.92; T6 = 1.30, 1.10, 0.98, 0.92; T7 = 1.38, 1.18, 1.06, 1.00; T8 = 1.46, 413 1.26, 1.14, 1.08.

Vantress, Inc. who work with live animals are provided with animal welfare training on a monthly, quarterly, and annual basis. Training includes relevant awareness topics for improving knowledge about animal welfare in their respective work area(s), poultry care and handling standards, and the importance of pro-active evaluation of behavior, quality, and environmental conditions so that poultry welfare is optimized.

Statistical Analysis

The experimental design for both trials was a randomized complete block design with one factor of 8 dietary treatments. The 8 dietary treatments fed to 6 replicate pens per treatment for a total of 48 pens arranged in 6 randomized blocks per experiment, where pen was the experimental unit. Wooden breast and white striping scores were converted to percentages of the proportions of total count for the pen. One-way ANOVA mean separation using Tukey-Kramer HSD was performed for BW gain, mortality feed to gain, total digestible Lys intake, processing yields as percentage of live BW, wooden breast score percentages, and white striping score percentages using JMP 14 software [10]. Blocking was considered a random effect and was not significant in any model for BW gain, feed to gain, total digestible Lys, processing yields, or breast fillet score percentages. JMP 14 nonlinear curve function with the broken-line model was used to determine the 0- to 14-D BW gain and feed to gain responses to digestible Lys. The two-slope linear broken-line model for prediction of optimal level of digestible Lys from 0 to 14 D was:

$$\mathrm{If}(\text{intercept } 1 - \text{intercept } 2) \div (\text{slope } 2 - \text{slope } 1) > \text{digestible Lys}, \%,$$

$$\text{then}(\text{intercept } 1 + \text{slope } 1) \times \text{digestible Lys}, \%;$$

$$\text{else}, (\text{intercept } 2 + \text{slope } 2) \times \text{digestible Lys}, \%$$

JMP 14 fit curve quadratic polynomial was used to determine the optimal level of digestible Lys intake for the responses of 53-D BW, 0- to 53-D feed to gain, and 54-D white meat yield. The estimation curve for the quadratic polynomial was defined as intercept + slope * digestible Lys intake + quadratic * digestible Lys intake^2.

RESULTS AND DISCUSSION

Many researchers have observed differences in nutrient needs based on genotype and gender [1]. Published data on Lys needs of the high-yielding genotype of the Cobb MV × Cobb 700 of either gender are sparse. The initial phase of the experiments herein was to determine the need of digestible Lys of the female and male Cobb MV × Cobb 700 broilers in the starting phase (0–14 D) by feeding birds on 8 levels of incrementally increasing digestible Lys.

Experiment 1 and 2: Live Performance

The two-slope linear broken line polynomial for the 0- to 14-D period generated asymptote responses to digestible Lys for female BW gain and FCR and male BW gain and FCR of 1.30, 1.30, 1.26, and 1.31%, respectively (Table 3). The female birds continued to respond to increased digestible Lys after the optimal levels, whereas the male birds had diminished responses. The female BW gain continued to increase after the asymptote, albeit at a reduced rate. Female FCR from 0 to 14 D decreased after the asymptote but at reduced rate before the asymptote. Male responses for BW gain and FCR after the asymptotes were opposite to those of the female birds, where BW gain after the asymptote was lower and FCR was higher. This conflicts with previous studies estimating the need of digestible Lys for optimal FCR response being higher than the level for optimal BW gain response [2, 11–14]. The quadratic polynomial for the 0- to 14-D period generated asymptote responses to digestible Lys intake for female BW gain and FCR and male BW gain and FCR of: 5.6, 6.8, 5.4, and 5.1 g, respectively (Table 4). This agrees with the work by Pesti and Miller [15] in that the need for BW gain and FCR is different.

Female and male BW gains from 0 to 41 D were the highest for T5 and different ($P < 0.0001$) than those for T3, with T4 gains being intermediate. Female BW gains from 0 to 53 D were the highest for T8 and different ($P < 0.0001$) than those for T3, with T4, T5, T6, and T7 gains being intermediate. However, the male BW gains from 0 to 53 D were highest for T6 and different ($P < 0.0001$) than those for T3, with T4 and T5 gains being intermediate. Female and male FCR from 0 to 41 D was lowest for T8 and different ($P < 0.0001$) than that for T6, with T7 FCR being intermediate. Female FCR from 0 to 53 D was lowest for T8 and different ($P < 0.0001$) than FCR for T7. However, the male FCR for the 0 to 53 D period was lowest for T8 and different ($P < 0.0001$) than that for T5, with T6 and T7 FCR being intermediate.

Female digestible Lys intake from 0 to 41 D was highest for T8 and different ($P < 0.0001$) than that for T7 (Table 5). However, the male digestible Lys intake from 0 to 41 D was highest for T8 and different ($P < 0.0001$) than T6, with T7 being intermediate. The female digestible Lys intake from 0 to 53 D was highest for T8 and different ($P < 0.0001$) than that for T6, with T7 Lys intake being intermediate. However, the male digestible Lys intake from 0 to 53 D was highest for T8 and different ($P < 0.0001$) than that for T7. Previously it has been reported that broilers that have insufficient digestible Lys intake early have a lower sensitivity to digestible Lys than birds fed with higher digestible Lys levels early [16]. The findings in this study suggests that the birds fed higher digestible Lys levels did not use their increased intake as efficiently as those fed lower digestible Lys levels for BW gain or FCR.

The female BW gain and FCR for 0 to 53 D and 54 D white meat yield quadratic responses to digestible Lys intake optimal levels were estimated at 57.3, 55.6, and 60.1 g, respectively (Table 4). This again conflicts with previous studies estimating the need of digestible Lys for optimal FCR response being higher than the level for optimal BW gain response [2, 11–14].

However, the male BW gain and FCR from 0 to 53 D and 54 D white meat yield quadratic responses to digestible Lys intake optimal levels were estimated at 63.1, 64.2, and 65.0 g, respectively. The male response would agree with previous work suggesting that the need for digestible Lys for FCR is greater than BW gain and even higher for white meat yield than FCR [2, 11–14].

Experiment 1 and 2: Processing Performance

Past studies conducted during the broiler starter phase of 0 to 14 D of age, the research was not extended to evaluate processing responses [6, 7]. Converting broilers that had been on differing levels of digestible Lys in the starter phase and then placing them on a basal diet up to processing would result in the extreme deficient digestible Lys broilers receiving a significant increase in digestible Lys at 14 D, or conversely the birds that had been fed an excess of digestible Lys having a significant decrease in digestible Lys at 14 D. For this research, we kept the birds at the 8 different levels of digestible Lys. Throughout the study, all diets within T5 were set at the Cobb 700 broiler recommendations for all nutrients including digestible lysine [5]. The recommendations of the NRC for digestible Lys could be compared with those of T4 [3].

Carcass yields are presented as percentages of live BW (Table 6). The debone market age (54 D) female carcass yields were highest on T6 and different ($P < 0.0001$) than those on T4, with T5 yields being intermediate. However, 54-D male carcass yield was highest at T4 and different ($P < 0.0001$) than that at T3. Female breast fillet yields were highest on T7 and different ($P < 0.0001$) than those on T5, with T6 yields being intermediate. However, male breast fillet yields were highest on T6 and different ($P < 0.0001$) than those on T4, with T5 yields being intermediate. The female tender yields were highest on T5 and different ($P < 0.0001$) than T3, with T4 being intermediate. Male tender yields were highest on T7 and different ($P < 0.0001$) than T4, with T5 and T6 being intermediate. Female thigh yields were highest for T1 and different ($P < 0.0001$) than T5, with T2, T3, and T4 being intermediate. Dietary treatments had no effect ($P > 0.05$) on male thigh yield or either sex of wing or drum yields. Female abdominal fat yield was highest for T1 and different ($P < 0.0001$) than T4, with T2 and T3 being intermediate. However, male abdominal fat yield was highest for T2 and different ($P < 0.0001$) than that for T7, with T3, T4, T5, and T6 yields being intermediate. As previously reported by Leclercq [2], the need for digestible Lys is highest for reducing abdominal fat as was also shown in this study.

Breast fillet myopathy scores are presented as percentage of fillets within categories (Table 7). Female breast fillet white striping scores of 0.5 was highest for T1 and T3, and they were different ($P = 0.0336$) than those for T8, with all other treatments being intermediate. Female breast fillet white striping scores of 1.0 were highest for T8 and different ($P = 0.0149$) than those for T3, with T2, T4, T5, T6, and T7 scores being intermediate. There was no effect on female breast fillet white striping scores of 0.0, 2.0, or 3.0. Male breast fillet white striping scores of 0.0 was highest for T1 and different ($P < 0.0001$) than those for T3, with T2 scores being intermediate. Male breast fillet white striping scores of 0.5 were highest ($P = 0.0261$) for T4 and were different than those for T5, with T1, T2, T3, T6, T7, and T8 scores being intermediate. The male breast fillet white striping scores of 1.0 were highest for T5 ($P = 0.0002$) and different than those for T1, T2, and T4, with T3, T6, T7, and T8 scores being intermediate. There was no treatment effect on male breast fillet white striping for scores 2.0 or 3.0. Female breast fillet wooden breast scores of 0.0 were highest at T1 and different ($P = 0.0007$) than those at T7, with T2, T3, T4, T5, and T6 scores being intermediate. Female breast fillet wooden breast scores of 3.0 were highest at T7 ($P = 0.0049$) and different than those at T1, T2, T3, and T5, with T4, T6, and T8 scores being intermediate. There was no treatment effect on female breast fillet wooden breast scores of 0.5, 1.0, 1.5, and 2.0. Male breast fillet wooden breast scores of 0.0 were highest at T1 ($P = 0.0004$) and different than those at T4, T5, T6, and T8, with T2, T3, and T7 scores being intermediate. Male breast fillet wooden breast scores of 3.0 were highest at T6, T7, and T8 ($P = 0.0002$) and different than those at T1, T2, T3, and T4, with T5 scores being intermediate. There was no treatment effect on male breast fillet wooden breast scores of 0.5, 1.0, 1.5, and 2.0.

The needs of the Cobb MV × Cobb 700 broiler for digestible Lys are different than those previously stated in the recommendations of the NRC and the Cobb 700 broiler nutrition guide [3, 5]. The digestible Lys need of the Cobb MV × Cobb 700 female and male broilers for BW gain from 0 to 14 D was estimated to be 1.30 and 1.26%, respectively, and the need for digestible Lys for FCR from 0 to 14 D of age was estimated to be 1.30 and 1.31%; respectively. More research will need to be performed to determine the dietary needs by growth phase for optimal response of valuable live production characteristics, processing yields, and meat quality. It would be of interest to understand the partitioning of crude protein and different amino acids as this work indicates that levels of excess may not be retained by the animal. Overall, female and male fillet yields were improved in T6 vs. T4, resulting in increased fillet weights of 82 and 125 g per bird, respectively.

CONCLUSIONS AND APPLICATIONS

1. Optimization of dietary digestible Lys in Cobb MV × Cobb 700 female broilers from 1 to 14 D occurred at 1.30% for both BW gain and FCR.
2. Live performance optimization of dietary digestible Lys in Cobb MV × Cobb 700 male broilers BW gain and FCR from 1 to 14 D occurred at 1.26 and 1.31%, respectively.
3. For female birds, optimization of live performance (1–53 D) and white meat yield (54 D) occurred at 56 and 60 g, respectively, of digestible Lys intake.
4. For live performance (1–53 D) and white meat yields (54 D) in male birds, dietary digestible Lys intake was optimized at 64 and 65 g, respectively.
5. Dietary digestible Lys optimization of fillet yields did not increase woody breast or white striping.

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