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AJINOMOTO HEARTLAND, INC.

POULTRY RESEARCH REPORT 21

Dietary Crystalline Threonine used to Lower Crude Protein and this Effect on Growth and Yield Performance of Broiler Chickens

Introduction

The future availability and price of L-Threonine should make it economical to use in broiler feeds. In addition to reducing the feed cost, utilizing L-Threonine results in lower crude protein feeds. However, industry nutritionist have expressed concern that formulating diets based solely on digestible amino acid values and ignoring the crude protein level, will lead to poorer growth performance and negatively affect carcass yield. This experiment was designed to address these issues. The study was conducted at Shur-Gain AgResearch, Burford, Ontario, Canada.

Objective

The purpose of this study was to determine the effects of lower crude protein feeds, incorporating L-Lysine, DL-Methionine and L-Threonine, on growth performance, carcass characteristics and mortality of broiler chickens. Diets were formulated to what we believe, are the minimum levels of the first seven limiting essential amino acids.

Materials and Methods

The composition of the basal diet used in the study was similar to those currently fed in the US. Diets were formulated on a digestible amino acid basis applying the Ajinomoto Heartland digestible amino acid coefficients to analyzed corn, soy and meat meal values. Two basal diets were formulated using the identical nutrient levels, the only difference being that L-Threonine was offered in one (Trt 5) and not the other (Trt 1). Based on a 2000 ingredient prices and a L-Threonine price of $2.70/kg, Treatment 5 brought in 600 grams of L-Threonine/ MT and reduced CP by 1.5 percentage points. Replacing intact protein with L-Lysine, DL Methionine and L-Threonine up to the point where Isoleucine, Valine and Arginine became marginal and limited further reduction of CP. See Table 1

Proportions of these two basal diets were blended together to achieve the intermediate treatments, which resulted in added L-Threonine levels of 0, 150, 300, 450 and 600 grams/ ton.

A total of 1,350 male and 1,350 female day-old Cobb 500 broiler chickens were randomly assigned to treatments on day 0. Birds were vaccinated for Marek's disease at the hatchery.

Extra birds from the same hatch were fed the control starter feed and used to replace birds that died during the first 5 days of the study.

Each treatment was replicated 6 times per sex, with 45 birds per pen, stocked at 1 sq. ft/ bird. Each pen contained four nipple type drinkers, which provided clean drinking water, *ad libitum*. Dry pelleted feed was provided *ad libitum* in tube-type feeders (one per pen) of 20-kg capacity. New chopped straw was used as bedding.

Lighting program, barn temperature, litter type and other management practices were typical of commercial broiler chicken producers. Birds, which died before noon on day 5, were replaced

Feeding Program

Birds where fed Broiler Starter 0-18 days, Grower 19 – 34 and Finisher 35 – 49 days.

All diets were pelleted and formulated to contain 60-ppm salinomycin (Coxistac 12%, 0.5 kg/tonne) as an aid in the prevention of coccidiosis and 55-ppm bacitracin methylene disalicyclate (BMD 110, 0.5 kg/tonne) for prevention of necrotic enteritis.

Table 1. Diet Formulation

Treatment	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Start Basal	Start 150	Start 300	Start 450	Start 600	Grow Basal	Grow 150	Grow 300	Grow 450	Grow 600	Fin Basal	Fin 150	Fin 300	Fin 450	Fin 600
Corn	57.5	58.6	59.7	60.8	61.9	59.7	60.9	62.1	63.3	64.5	62.6	63.7	64.9	66.1	67.3
Soybean	30.8	29.8	28.9	28.0	27.0	28.6	27.6	26.5	25.4	24.3	24.8	23.7	22.7	21.6	20.5
Meat Meal	3.50	3.4	3.3	3.1	3.00	3.50	3.5	3.5	3.5	3.50	4.00	4.00	4.00	4.00	4.00
Feed Fat	3.91	3.8	3.6	3.4	3.27	4.29	4.1	3.9	3.7	3.53	5.03	4.84	4.65	4.47	4.28
L-Lys	0.070	0.103	0.135	0.168	0.200	0.010	0.044	0.079	0.113	0.147	0.01	0.04	0.07	0.11	0.14
DL-Meth	0.230	0.240	0.250	0.260	0.270	0.176	0.186	0.195	0.205	0.214	0.14	0.15	0.16	0.17	0.18
L-Thr	0.000	0.015	0.030	0.045	0.060	0.000	0.015	0.031	0.046	0.061	0.00	0.02	0.03	0.05	0.06
DiCal	1.12	1.16	1.19	1.23	1.26	1.04	1.04	1.05	1.06	1.07	0.91	0.92	0.93	0.94	0.95
Limestone	1.00	1.01	1.03	1.04	1.05	0.80	0.80	0.80	0.80	0.80	0.65	0.65	0.65	0.65	0.65
Salt	0.34	0.34	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.33
Vits & Min	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Choline Cl	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Lignosol	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Calculated from Analyzed Ingredients															
ME kcal/kg	3100	3100	3100	3100	3100	3150	3150	3150	3150	3150	3225	3225	3225	3225	3225
Protein	22.0	21.6	21.2	20.9	20.5	21.1	20.7	20.3	19.9	19.6	19.7	19.3	19.0	18.6	18.2
Nitrogen	3.48	3.42	3.36	3.30	3.24	3.37	3.31	3.25	3.19	3.13	3.15	3.09	3.04	2.98	2.92
Arginine	1.42	1.39	1.36	1.32	1.29	1.36	1.33	1.30	1.26	1.23	1.25	1.22	1.19	1.16	1.13
Dig. Arg	1.31	1.28	1.25	1.22	1.19	1.25	1.22	1.19	1.16	1.13	1.15	1.12	1.09	1.06	1.03
Isoleucine	0.88	0.86	0.85	0.83	0.81	0.84	0.82	0.80	0.78	0.76	0.78	0.76	0.74	0.72	0.70
Dig. Ile	0.80	0.78	0.76	0.75	0.73	0.76	0.74	0.73	0.71	0.69	0.70	0.68	0.67	0.65	0.63
Lysine	1.23	1.23	1.23	1.22	1.22	1.12	1.12	1.12	1.11	1.11	1.03	1.03	1.03	1.02	1.02
Dig. Lys	1.10	1.10	1.10	1.10	1.10	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.91	0.91
Meth	0.56	0.57	0.57	0.58	0.58	0.50	0.51	0.51	0.52	0.52	0.45	0.45	0.46	0.46	0.46
Dig. Meth	0.54	0.54	0.54	0.55	0.55	0.48	0.48	0.48	0.49	0.49	0.42	0.43	0.43	0.43	0.44
M+C	0.91	0.91	0.91	0.91	0.91	0.84	0.84	0.84	0.83	0.83	0.77	0.77	0.77	0.76	0.76
Dig M+C	0.82	0.82	0.82	0.82	0.82	0.75	0.75	0.75	0.75	0.75	0.68	0.68	0.68	0.68	0.68
Thr	0.82	0.82	0.82	0.82	0.82	0.79	0.79	0.79	0.78	0.78	0.74	0.74	0.74	0.73	0.73
Dig. Thr	0.71	0.71	0.71	0.71	0.71	0.68	0.68	0.68	0.68	0.68	0.63	0.63	0.63	0.63	0.63
Trp	0.23	0.23	0.22	0.22	0.21	0.22	0.21	0.21	0.20	0.19	0.20	0.19	0.19	0.18	0.17
Dig. Trp	0.20	0.19	0.19	0.18	0.18	0.19	0.18	0.17	0.17	0.16	0.17	0.16	0.16	0.15	0.15
Valine	1.00	0.98	0.96	0.94	0.92	0.96	0.94	0.93	0.91	0.89	0.90	0.88	0.87	0.85	0.83
Dig. Val	0.89	0.88	0.86	0.84	0.83	0.86	0.84	0.82	0.81	0.79	0.80	0.79	0.77	0.75	0.74
Glycine	1.06	1.04	1.01	0.99	0.97	1.03	1.01	1.00	0.98	0.96	0.99	0.97	0.96	0.94	0.92
Avail. Phos	0.45	0.45	0.45	0.45	0.45	0.43	0.43	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.42
Calcium	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90	0.90	0.85	0.85	0.85	0.85	0.85
Sodium	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

Carcass evaluation

After final bodyweight determination, five birds from each pen were randomly selected and double wing- banded with a bird-specific identification number. Birds were processed at a local plant, chilled, weighed (whole carcass), cut into the following portions and weighed:

1. Bone-in, skin-on breast – combined weight of two halves
2. Total deboned breast muscle (combined pectorialis major and pectoralis minor)

Results and Discussion

Table 2. Treatment by sex on body weight, feed intake and FCR												
Trt	Sex	Body Mass (gram)				Feed Intake g/b/day			FCR			Mort
		0	19	35	49	0 - 19	19 - 35	35 - 49	0 - 19	0 - 35	0 - 49	%
1	F	43.1	561	1717	2650	38	126	162	1.293	1.597	1.899	1.85
2	F	43.7	579	1721	2654	39	127	164	1.260	1.604	1.910	0.74
3	F	43.4	570	1754	2696	39	129	167	1.295	1.592	1.904	1.48
4	F	43.6	589	1749	2709	39	129	170	1.263	1.604	1.912	1.85
5	F	43.4	574	1731	2667	39	128	166	1.301	1.617	1.917	0.74
1	M	44.1	634	1973	3030	41	145	178	1.220	1.563	1.846	5.56
2	M	44.0	634	2013	3081	40	148	186	1.219	1.556	1.870	3.33
3	M	43.9	657	1988	3061	42	147	183	1.224	1.597	1.876	3.70
4	M	44.1	641	1955	3060	42	148	186	1.242	1.624	1.886	2.59
5	M	43.8	639	2024	3091	42	149	184	1.239	1.570	1.868	3.33
1	M & F	43.6	598	1845	2840	40	136	170	1.257	1.580	1.873	3.71
2	M & F	43.9	607	1867	2868	40	138	175	1.240	1.580	1.890	2.04
3	M & F	43.7	614	1871	2879	41	138	175	1.260	1.595	1.890	2.59
4	M & F	43.7	615	1852	2885	41	139	178	1.253	1.614	1.899	2.22
5	M & F	44.0	607	1878	2879	41	139	175	1.270	1.594	1.893	2.04
	SEM	0.3	17.0	38	37	1.0	2.0	3.0	0.017	0.024	0.010	NA

Growth Performance

Males had significantly higher bodyweights than females on days 0 ($P<0.01$), 19 ($P<0.001$), 35 ($P<0.001$) and 49 ($P<0.001$). Final (day 49) bodyweights of males and females were 3.065 kg and 2.675 kg, respectively and were representative of typical commercial roasters. Males had significantly ($P<0.001$) greater daily feed intake per live bird day during the starter, grower, and finisher periods. Overall mortality-adjusted feed conversion ratios of males and females were 1.869 and 1.908, respectively ($P<0.001$).

There were no significant main effects ($P>0.10$) of dietary treatment on bodyweight, feed intake or feed conversion ratio of roasters **(Table 2; Figures 1 – 4)**

Carcass characteristics

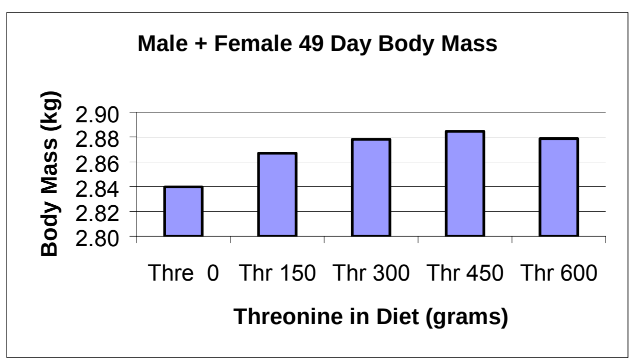
Because of their greater final bodyweight, males had significantly ($P<0.001$) better carcass yield (% of bodyweight) than females. Bone-in skin-on breast yield (% of carcass weight) and boneless breast yield (% of carcass weight) were significantly ($P<0.001$; $P<0.05$) lower for males than females.

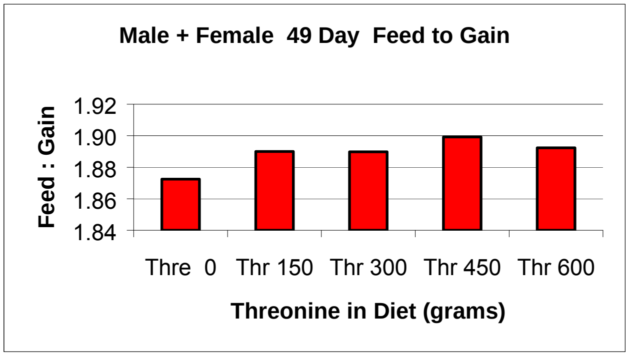
There was no tendency ($P>0.10$) towards any effect of dietary treatment on carcass characteristics of roasters. Treatment means for carcass yield (% of bodyweight) were very similar, ranging from 71.30% (Treatment 1) to 71.32%. Means for bone-in, skin-on breast yield ranged from 41.40 (Treatment 1) to 41.90% (**Table 3**).

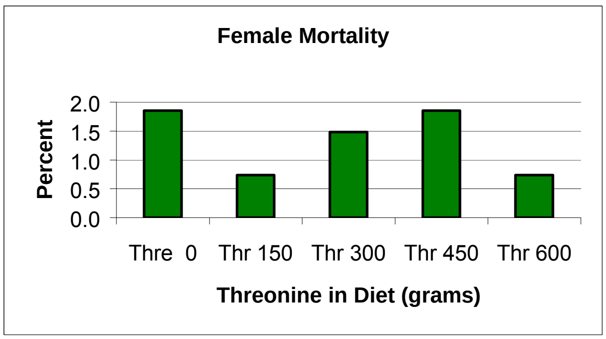
Table 3. Treatment by sex on body weight, feed intake and FCR

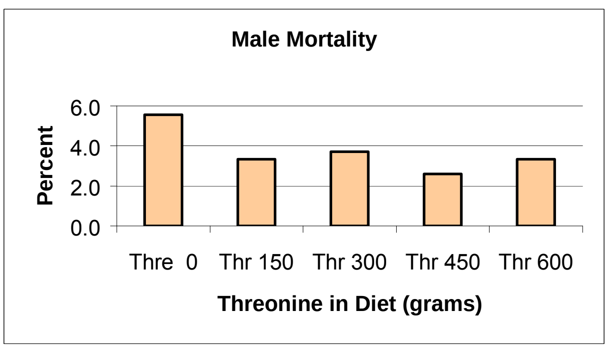
Trt	Carcass Yield %	Bone-in Breast %	Boneless Breast %
1	71.30	41.40	24.02
2	71.42	41.86	24.41
3	71.51	41.52	24.05
4	71.47	41.90	24.51
5	71.32	41.52	23.83
SEM	0.24	0.24	0.26
Female	70.65	42.25	24.45
Male	72.16	41.02	23.88
SEM	0.15	0.15	0.16
Signifi.	***	***	*

SEM, Standard error of mean
Signifi., significance of sex effect: P>0.05, (NS),P<0.05 (%), P<0.01(**), P<0.001 (***)
There was no significant (P<0.05) trmt or trmt x sex effect by any variable









Conclusions

1) The growth performance and survivability of male and female birds in this study were representative of commercial roasters.
2) Males had better final bodyweight (P<0.001), overall feed efficiency (P<0.001) and carcass yield (% of bodyweight; P<0.001) than females.
3) Males had higher (P<0.001) mortality than females.
4) Substitution of synthetic amino acids, Lysine, Methionine and Threonine for intact feedstuff Crude Protein had no tendency (P>0.10) to affect growth performance or carcass yield, as long as diets are formulated on a digestible basis and care is taken to meet all minimum essential amino acid levels.

Bibliography

Data on file at Ajinomoto Heartland LLC (2000)

Table 4. Financial assessments of treatments using August 2000 ingredient and meat prices

TRT	Tot Feed c/bird	Carcass Yiled %	Carcass Mass kg	Gross In Bird $	Net $/bird (Carc-Fd)	Savings c/bird
1	66.20	71.30	2.03	2.64	1.97	0.00
2	67.88	71.42	2.05	2.67	1.99	1.34
3	67.74	71.51	2.06	2.68	2.00	2.62
4	68.51	71.47	2.06	2.68	2.00	2.59
5	67.90	71.31	2.05	2.67	1.99	1.98

8430 W. Bryn Mawr, Suite 650 · Chicago, IL 60631-3421
Tel: 773-380-7000 ■ www.lysine.com