

Evaluation of the effects of ESSENTIAL on nursery performance under US commercial conditions

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Executive Summary

1,125 barrows and gilts (11.36 ± 2.08 lbs; mean \pm SD) were randomly allocated to pens within sex at the time of arrival with the lightest 10% forming one replicate. All pens were allotted to study within blocks that were equal in starting weight and sex. Treatments were arranged in blocks of 5 consecutive pens throughout the barn. There were 25 pigs per pen, resulting in 9 replicates per treatment. Each block consisted of one pen of each treatment. Nursery diet changes occurred in three phases with phase one (**N1**) lasting 7 days, phase two (**N2**) 14 days, and phase three (**N3**) 21 days. Pens of pigs were fed with a Howema feed system to record feed intake. Pen weights (**Wt**) and feed intake information were collected every 2 weeks to allow for calculation of average daily gain (**ADG**), average daily feed intake (**ADFI**), and feed efficiency (**FE**). Standard treatments for illness, if given, were documented throughout the duration of the trial. Mortalities and pen removals were weighed and information was recorded pertaining to the time of removal and the reason for removal/death. Growth characteristics, removal percentage, diarrhea and pen scour scores were analyzed as a randomized complete block design using PROC GLIMMIX procedures of SAS with pen as the experimental unit, treatment as main effect, and block as random effect. Results were considered significant at $P \leq 0.05$ and considered a trend at $P > 0.05$ and $P \leq 0.10$. At N1, there was a significant difference in F:G ($P < 0.034$) and removals ($p < 0.008$). Pen scour scores were not different between treatment groups. In conclusion, there was a difference in feed conversion and removals during N1. However, no differences between treatments were observed in pen scour scores, and no differences in growth performance was observed for the overall study period between the treatments.

Materials and Methods

Design and Treatments

The study was a randomized complete block design (RCBD) with pen weight as the blocking factor. The study was conducted from weaning until the end of nursery (N3 - 50 lbs approx. or 42 days). Nursery diet changes occurred in three phases with phase one (**N1**) lasting 7 days, phase two (**N2**) 14 days, and phase three (**N3**) 21 days.

Dietary treatments consisted of the following:

1. **Trt1:** diet with Mecadox® (Phibro Animal Health Corp™) at the recommended inclusion.
 - N1: Mecadox® at 50g/ton.
 - N2: Mecadox® at 50g/ton.
 - N3: No inclusion of Mecadox®.
 2. **Trt2:** diet with **ESSENTIAL** at the recommended inclusion. Diet did not contain other drugs (particularly AB).
 - N1: **ESSENTIAL** at 3lbs/ton of feed.
 - N2: **ESSENTIAL** at 3lbs/ton of feed.
 - N3: No inclusion of **ESSENTIAL**.
 3. **Trt3:** diet with Mecadox® and **ESSENTIAL** at the recommended inclusion.
 - N1: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N2: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N3: No inclusion of Mecadox® and **ESSENTIAL**.
 4. **Trt4:** diet with Mecadox® and **ESSENTIAL** at the recommended inclusion.
 - N1: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N2: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N3: No inclusion of Mecadox® and **ESSENTIAL** at 3lbs/ton of feed.
 5. **Trt1:** diet with Mecadox® and **ESSENTIAL** at the recommended inclusion.
 - N1: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N2: Mecadox® at 50g/ton + **ESSENTIAL** at 3lbs/ton of feed.
 - N3: No inclusion of Mecadox® and **ESSENTIAL** at 2lbs/ton of feed
- ❖ For all treatments, N1 and N2 diets contained Zinc Oxide at 2700ppm inclusion rate.

Feed budget

- N1 = 3 lbs/pig
- N2 = 15 lbs/pig
- N3 = 45 lbs/pig

Pen weights

Pens will be weighed every two weeks with the following dates:

- D0/placement = March 11th
- D14 = March 25th
- D28 = April 8th
- D42/end of study = April 22th

Animals

1,125 barrows and gilts (11.36 ± 2.08 lbs; mean \pm SD) were randomly allocated into pens within sex at the time of arrival with the lightest 10% forming one replicate. All pens were allotted to study within blocks that were equal in starting weight and sex. Treatments were arranged in blocks of 5 consecutive pens throughout the barn. There were 25 pigs per pen, resulting in 9 replicates per treatment. Each block consisted of one pen of each treatment.

Diets

Treatment diets were fed as follows: N1 d0-7 pelleted, N2 d7-21 meal and N3 d21-42 meal. All diets were formulated to meet or exceed current NRC recommendations and were manufactured at a local toll mill and delivered to the farm. In addition, diets were formulated to meet PIC lysine requirements and reviewed by the study sponsor. Dietary treatment nutrient specifications are shown in Appendix Tables A-C.

Procedures

Pens of pigs were fed with a Howema feed system to record feed intake. Pen weights (**Wt**) and feed intake information were collected at every 2 weeks to allow for calculation of average daily gain (**ADG**), average daily feed intake (**ADFI**), and feed gain (**F:G**). **ADG** was calculated as the weight gain of the pen during each diet phase and overall for the nursery period (N1-N3), divided by the number of days on treatment per pen at each phase and overall. **ADFI** was calculated as the total feed consumed (lbs.) per pen at each phase/overall divided by the number of days on treatment per pen at each phase and overall. **F:G** was calculated as the amount of feed delivered (lbs.) per pen divided by the weight gain of the pen during each phase and overall. Standard treatments for illness, were given, and documented throughout the duration of the trial. Mortalities and pen removals were weighed, and information was recorded pertaining to the time of removal and the reason for removal/death. Pen scour scores (**SS**) were collected starting at the allotment (d0), d4, d7, and d14, by pen, and observed by the same person. Pen scores were done using a 5-point-system as follows:

- 0. no scouring pigs.
- 1. 25% of the pen affected.
- 2. 50% of the pen affected.
- 3. 75% of the pen affected.
- 4. 100% of the pen affected.

Statistical Analysis

Experimental data were analyzed as a randomized complete block design using PROC GLIMMIX of SAS with pen serving as the experimental unit and blocks included as random effects. Growth performance characteristics were analyzed according to a normal distribution. Removals (%) and pen scour scores (%) (repeated measures) were analyzed using a binomial distribution. The results were considered significant at $P < 0.05$ and marginally significant at $0.05 < P < 0.10$.

In addition, per sponsor request treatments groups having similar diets were grouped and experimental data were reanalyzed. For phase 1 (0-14) and phase 2 (14-28) T3, T4 and T5 were considered one treatment (T3), and for phase 3 (28-42) treatments T1, T2, and T3 were considered one treatment (T1).

Results and Discussion

There were no significant differences in initial starting weight between treatments ($P = 0.938$; Table 1).

Dietary treatment proximate and amino acid analysis are shown in Appendix Tables D-I.

Growth performance and removals (%)

At Phase 1, there were significant differences ($P < 0.05$) in average F:G (T1 vs. T2) and percentage removals (T3 vs. T4) (Table 1).

Table 2 describes the updated analyze. At Phase 1, there was a significant difference ($P < 0.05$) in F:G (T1 vs. T2).

Pen scour scores

There was no significant difference between groups (Table 1). However, the within subject (pen) test indicate that there is a significant time effect, in other words, the groups do change in scour scores over time but not due to the treatment. Figure 1 describes the changes on pen scour scores over time.

Conclusion

There were differences in growth performance and percentage removals during N1. There was no difference in pen scour score between dietary treatment groups. There were no differences in growth performance observed in the overall study period. It is interesting to note that Treatment 2 (Essential only) resulted in similar performance to all treatments that included Mecadox. This result deserves further investigation and validation, particularly in large scale field evaluations.

Table 1. Effects of IFTA NBS supplementation on growth performance, removals and scour scores.

	T1	T2	T3	T4	T5	SEM	P-Value
	Mecadox (N1 and N2)	Essential (N1 and N2)	Mecadox + Essential (N1 and N2)	Mecadox + Essential (N1 and N2 + N3 3lbs/ton)	Mecadox + Essential (N1 and N2 + N3 2lbs/ton)		
Start wt, lbs	11.36	11.37	11.36	11.36	11.36	0.728	0.938
Phase 1 (D0-14)							
Wt, lbs	17.72	17.30	17.60	17.65	17.63	1.052	0.586
ADG, lbs	0.45	0.42	0.45	0.43	0.43	0.273	0.539
ADFI, lbs	0.44	0.50	0.48	0.46	0.47	0.042	0.259
F:G, lbs	0.96 ^a	1.20 ^b	1.10 ^{ab}	1.06 ^{ab}	1.09 ^{ab}	0.056	0.034
Phase 1 Removals, % ^{1,2}	1.78% ^{ab}	1.33% ^{ab}	0.00% ^a	4.44% ^b	3.11% ^{ab}	-	0.008
Phase 2 (D14-28)							
Wt, lbs	31.19	30.69	31.24	30.97	31.35	1.653	0.720
ADG, lbs	0.96	0.96	0.97	0.95	0.98	0.045	0.746
ADFI, lbs	1.48	1.44	1.45	1.45	1.44	0.079	0.860
F:G, lbs	1.54	1.50	1.47	1.52	1.48	0.026	0.310
Phase 2 Removals, % ^{1,2}	0.45%	0.00%	0.00%	0.00%	0.00%	-	0.594
Phase 3 (D28-42)							
Wt, lbs	50.24	49.66	50.12	50.03	49.97	2.307	0.967
ADG, lbs	1.33	1.31	1.35	1.35	1.32	0.485	0.575
ADFI, lbs	2.07	2.07	2.10	2.11	2.09	0.098	0.729
F:G, lbs	1.55	1.57	1.56	1.56	1.57	0.023	0.847
Phase 3 Removals, % ¹	2.26%	2.69%	0.88%	1.39%	0.46%	0.008	0.374
Overall (D0-42)							
ADG, lbs	0.91	0.90	0.92	0.90	0.91	0.393	0.655
ADFI, lbs	1.32	1.33	1.35	1.33	1.33	0.072	0.963
F:G, lbs	1.44	1.49	1.46	1.47	1.46	0.019	0.176
Nursery Removals, % ¹	4.34%	3.56%	0.78%	5.17%	3.16%	0.013	0.169

Table 1. Effects of IFTA NBS supplementation on growth performance, removals and scour scores.

	T1	T2	T3	T4	T5	SEM	<i>P-Value</i>
	Mecadox (N1 and N2)	Essential (N1 and N2)	Mecadox + Essential (N1 and N2)	Mecadox + Essential (N1 and N2 + N3 3lbs/ton)	Mecadox + Essential (N1 and N2 + N3 2lbs/ton)		
Scour Score³						<i>Treatment</i>	0.397 ⁴
						<i>Day</i>	<0.001 ⁵
d0	0.00%	0.00%	0.00%	0.00%	0.00%	0.125	-
d3	66.70%	77.80%	44.40%	55.60%	33.30%	0.125	-
d7	0.00%	33.30%	11.10%	0.00%	55.60%	0.125	-
d14	11.10%	11.10%	11.10%	0.00%	11.10%	0.125	-

^{ab}Least Squares Means with the same letter are not significantly different (Tukey-Kramer adjustment, Alpha=0.05).

¹Removals, %: include animals removed and found dead.

²Fisher's Exact Test was used and estimates were based on total animals at the beginning and end of phase, not pen data (binomial model didn't converge).

³Generalized linear mixed model for repeated measures was used to evaluate the effect of treatment and time on scour score.

⁴P-value for fixed effect – dietary treatment.

⁴P-value for time effect – day of observation.

Table 2. Updated table – Treatments T3, T4 and T5 were grouped in phase 1 and 2, and treatments T1, T2, and T3 were grouped in phase 3.

	T1 Mecadox (N1 and N2)	T2 Essential (N1 and N2)	T3 Mecadox + Essential (N1 and N2)	T4 Mecadox + Essential (N1 and N2 + N3 3lbs/ton)	T5 Mecadox + Essential (N1 and N2 + N3 2lbs/ton)	SEM	<i>P-Value</i>
Start wt, lbs	11.36	11.37	11.36	11.36	11.36	0.728	0.938
Phase 1 (D0-14)							
Wt, lbs	17.72	17.30	17.63			1.053	0.235
ADG, lbs	0.45	0.42	0.44			0.028	0.348
ADFI, lbs	0.44	0.50	0.47			0.041	0.089
F:G, lbs	0.96 ^a	1.20 ^b	1.09 ^{ab}			0.055	0.006
Phase 1 Removals, % ¹	1.11%	0.78%	1.49%			0.008	0.555
Phase 2 (D14-28)							
Wt, lbs	31.19	30.69	31.18			1.652	0.464
ADG, lbs	0.96	0.96	0.97			0.045	0.830
ADFI, lbs	1.48	1.44	1.45			0.078	0.512
F:G, lbs	1.54	1.50	1.49			0.026	0.246
Phase 2 Removals, % ^{1,2}	0.45%	0.00%	0.00%			-	0.403
Phase 3 (D28-42)							
Wt, lbs	50.01			50.03	49.97	2.305	0.997
ADG, lbs	1.33			1.35	1.32	0.049	0.526
ADFI, lbs	2.08			2.11	2.09	0.097	0.620
F:G, lbs	1.56			1.56	1.57	0.023	0.682
Phase 3 Removals, % ¹	1.94%			1.39%	0.46%	0.008	0.360

^{ab}Least Squares Means with the same letter are not significantly different (Tukey-Kramer adjustment, Alpha=0.05).

¹Removals, %: include animals removed and found dead.

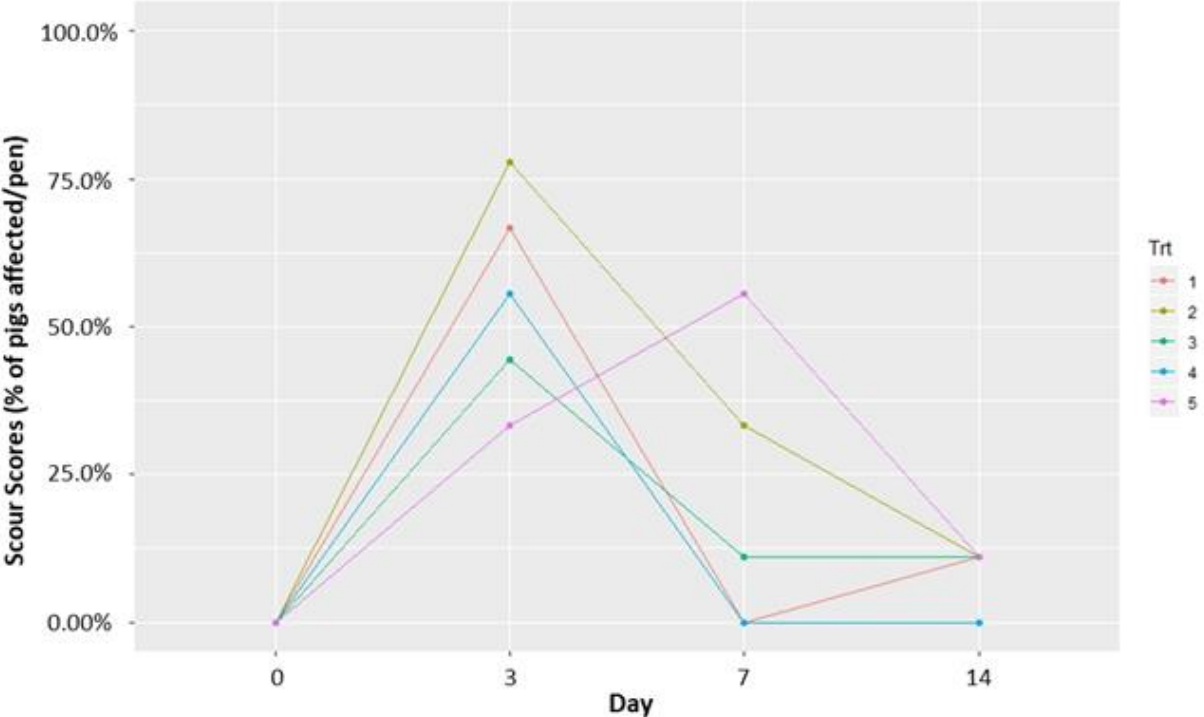
²Fisher's Exact Test was used and estimates were based on total animals at the beginning and end of phase, not pen data (binomial model didn't converge).

³Generalized linear mixed model for repeated measures was used to evaluate the effect of treatment and time on scour score.

⁴P-value for fixed effect – dietary treatment.

⁴P-value for time effect – day of observation.

Figure 1. Effects of ESSENTIAL supplementation on pen scour score over time.



Appendix.

Table A. Phase N1: Experimental Diet Compositions.			
Item	T1	T3/T4/T5	T2
Corn 2015	31.73	31.57	31.83
SBM 47.5 CP	17.50	17.50	17.50
Fat CWG	3.00	3.00	3.00
Zinc Oxide	0.38	0.38	0.38
Monocal Phosphate	0.55	0.55	0.55
Calcium Carbonate	1.00	1.00	1.00
Salt	0.30	0.30	0.30
Fishmeal Special Select	4.52	4.53	4.52
L-Lysine HCl	0.45	0.45	0.45
L-Threonine	0.15	0.15	0.15
L-Tryptophan	0.05	0.05	0.05
Novus MHA	0.22	0.23	0.22
hp 300	5.00	5.00	5.00
L-Valine	0.07	0.07	0.07
Copper sulfate	0.08	0.08	0.08
DairyLac 80	17.50	17.50	17.50
Dried Whey	2.50	2.50	2.50
Feeding Oatmeal	10.00	10.00	10.00
EC OTM	0.15	0.15	0.15
EC Vitamin Pak w/Phyt Sow	0.05	0.05	0.05
Ronozyme Hi Phos	0.03	0.03	0.03
SalCurb HiLys	0.33	0.33	0.33
Mecadox 10	0.25	0.25	-
AP920	4.13	4.13	4.13
Myvatex	0.08	0.08	0.08
Essential	-	0.15	0.15
Total	100.00	100.00	100.00
Mod ME	1530.20	1527.90	1531.70
CP	22.52	22.51	22.52
CF	5.30	5.30	5.40
Ca	0.93	0.93	0.93
P	0.71	0.71	0.71
aP	0.60	0.60	0.60
Sodium	0.44	0.44	0.44
Ca:P	1.31	1.31	1.31
Ca:aP	1.55	1.56	1.55
Phytase	625.56	625.56	625.56
Phytase Av Phos	0.12	0.12	0.12
TOT Lys	1.67	11.67	1.67
SID Lys	1.46	1.46	1.46
SID M+C:Ly	0.58	0.58	0.58
SID Thr:Ly	0.60	0.60	0.60
SID Trp:Ly	0.20	0.20	0.20

Table B. Phase N2: Experimental Diet Compositions.

Item	T1	T3/T4/T5	T2
Corn 2015	35.73	35.56	35.83
SBM 47.5 CP	22.50	22.50	22.50
Fat CWG	3.25	3.25	3.25
Zinc Oxide	0.38	0.38	0.38
Monocal Phosphate	0.38	0.38	0.38
Calcium Carbonate	0.73	0.73	0.73
Salt	0.35	0.35	0.35
Fishmeal Special Select	4.00	4.00	4.00
L-Lysine HCl	0.45	0.45	0.45
L-Threonine	0.14	0.14	0.14
L-Tryptophan	0.03	0.03	0.03
Novus MHA	0.26	0.26	0.26
hp 300	3.45	3.46	3.44
L-Valine	0.06	0.06	0.06
Copper sulfate	0.08	0.08	0.08
DairyLac 80	15.00	15.00	15.00
EC Vitamin Pak w/Phyt Sow	0.05	0.05	0.05
Ronozyme Hi Phos	0.03	0.03	0.03
SalCurb HiLys	0.33	0.33	0.33
Mecadox 10	0.25	0.25	-
AP920	2.50	2.50	2.50
Essential	-	0.15	0.15
DDGS Big River	5.00	5.00	5.00
Oat Groats	5.00	5.00	5.00
EC Trace Mineral	0.10	0.10	0.10
Total	100.00	100.00	100.00
Mod ME	1533.70	1531.50	1535.20
CP	23.01	23.01	23.01
CF	5.770	5.70	5.70
Ca	0.75	0.75	0.75
P	0.65	0.65	0.65
aP	0.52	0.52	0.52
Sodium	0.38	0.38	0.38
Ca:P	1.14	1.15	1.14
Ca:aP	1.43	1.43	1.43
Phytase	625.56	625.56	625.56
Phytase Av Phos	0.12	0.12	0.12
TOT Lys	1.64	1.64	1.64
SID Lys	1.42	1.42	1.42
SID M+C:Ly	0.58	0.58	0.58
SID Thr:Ly	0.60	0.60	0.60
SID Trp:Ly	0.19	0.19	0.19

Table C. Phase N3: Experimental Diet Compositions.

Item	T1/T2/T3	T3	T4
Corn 2015	41.93	41.79	41.83
SBM 47.5 CP	31.63	31.63	31.63
Fat CWG	3.00	3.00	3.00
Monocal Phosphate	0.35	0.35	0.35
Calcium Carbonate	1.30	1.30	1.30
Salt	0.50	0.50	0.50
L-Lysine HCl	0.52	0.51	0.52
L-Threonine	0.09	0.09	0.09
L-Tryptophan	0.02	0.02	0.02
Novus MHA	0.17	0.17	0.17
EC Vitamin Pak w/Phyt Sow	0.05	0.05	0.05
Ronozyme Hi Phos	0.03	0.03	0.03
SalCurb HiLys	0.33	0.33	0.33
Essential	-	0.15	0.10
DDGS Big River	20.00	20.00	20.00
EC Trace Mineral	0.10	0.10	0.10
Total	100.00	100.00	100.00
Mod ME	1510.80	1508.50	1509.30
CP	24.27	24.26	24.26
CF	6.10	6.10	6.10
Ca	0.72	0.72	0.72
P	0.55	0.55	0.55
aP	0.37	0.37	0.37
Sodium	0.25	0.25	0.25
Ca:P	1.30	1.30	1.30
Ca:aP	1.95	1.95	1.95
Phytase	625.56	625.56	625.56
Phytase Av Phos	0.12	0.12	0.12
TOT Lys	1.57	1.57	1.57
SID Lys	1.33	1.33	1.33
SID M+C:Ly	0.58	0.58	0.58
SID Thr:Ly	0.60	0.60	0.60
SID Trp:Ly	0.19	0.19	0.19

Table D. Phase N1: Experimental Diet Proximate Analyses.

Item	T1	T2	T3	T4	T5
Moisture, %	10.49	10.63	10.14	10.14	10.14
Dry Matter, %	89.51	89.37	89.86	89.86	89.86
CP, %	22.10	24.30	23.4	23.4	23.4
ADF, %	2.40	3.10	2.40	2.40	2.40
Total Digestible Nutrients, %	81.30	80.40	81.60	81.60	81.60
Ca, %	1.04	0.86	0.95	0.95	0.95
P, %	0.68	0.63	0.65	0.65	0.65
K, %	1.11	1.10	1.16	1.16	1.16
Mg, %	0.16	0.16	0.15	0.15	0.15
Zn, ppm	2158.8	1868.6	2032.70	2032.70	2032.70
Fe, ppm	90.00	53.00	82.00	82.00	82.00
Mn, ppm	85.00	85.00	82.00	82.00	82.00
Cu, ppm	181.30	127.90	148.10	148.10	148.10
S, %	0.31	0.29	0.29	0.29	0.29
Na, %	0.35	0.33	0.35	0.35	0.35
Mo, ppm	1.48	1.09	1.33	1.33	1.33

Table E. Phase N1: Experimental Diet Complete Amino Acid Profiles.

Item	T1	T2	T3	T4	T5
Moisture, %	12.06	11.99	11.56	11.56	11.56
Dry Matter,%	87.94	88.01	88.44	88.44	88.44
CP, %	23.56	2.353	22.94	22.94	22.94
Fat, %	4.54	4.44	4.37	4.37	4.37
Fiber, %	1.94	1.87	1.65	1.65	1.65
Lys, %	1.62	1.64	1.61	1.61	1.61
Thr, %	1.07	1.07	1.06	1.06	1.06
Met, %	0.44	0.44	0.44	0.44	0.44
Cys, %	0.36	0.36	0.36	0.36	0.36
TSAA, %	0.80	0.80	0.80	0.80	0.80
Trp, %	0.27	0.27	0.27	0.27	0.27
Val, %	1.12	1.13	1.09	1.09	1.09
Ile, %	0.92	0.93	0.90	0.90	0.90
Leu, %	1.85	1.88	1.82	1.82	1.82
Arg, %	1.39	1.40	1.33	1.33	1.33
Ala, %	1.11	1.12	1.08	1.08	1.08
Asp, %	2.32	2.34	2.25	2.25	2.25
Glu, %	3.64	3.62	3.54	3.54	3.54
Gly, %	0.95	0.95	0.92	0.92	0.92
His, %	0.58	0.59	0.57	0.57	0.57
Phe, %	1.07	1.07	1.03	1.03	1.03
Pro, %	1.19	1.19	1.15	1.15	1.15
Ser, %	1.13	1.14	1.10	1.10	1.10
Tyr, %	0.54	0.54	0.52	0.52	0.52

Table F. Phase N2: Experimental Diet Proximate Analyses.

Item	T1	T2	T3	T4	T5
Moisture, %	11.30	10.69	10.84	10.84	10.84
Dry Matter, %	88.70	89.31	89.16	89.16	89.16
CP, %	23.00	22.70	23.00	23.00	23.00
ADF, %	3.30	3.10	3.60	3.60	3.60
Total Digestible Nutrients, %	79.60	80.30	79.70	79.70	79.70
Ca, %	0.83	0.91	0.86	0.86	0.86
P, %	0.60	0.60	0.61	0.61	0.61
K, %	1.09	1.07	1.10	1.10	1.10
Mg, %	0.17	0.16	0.16	0.16	0.16
Zn, ppm	1935.40	2375.80	2308.80	2308.80	2308.80
Fe, ppm	132.00	100.00	125.00	125.00	125.00
Mn, ppm	62.00	76.00	65.00	65.00	65.00
Cu, ppm	203.5	199.50	182.40	182.40	182.40
S, %	0.29	0.29	0.29	0.29	0.29
Na, %	0.29	0.30	0.29	0.29	0.29
Mo, ppm	1.09	1.00	1.13	1.13	1.13

Table G. Phase N2: Experimental Diet Complete Amino Acid Profiles.

Item	T1	T2	T3	T4	T5
Moisture, %	12.79	12.31	12.48	12.48	12.48
Dry Matter,%	87.21	87.69	87.52	87.52	87.52
CP, %	23.63	23.91	25.06	25.06	25.06
Fat, %	4.91	4.99	4.81	4.81	4.81
Fiber, %	2.78	2.61	2.91	2.91	2.91
Lys, %	1.56	1.61	1.66	1.66	1.66
Thr, %	1.05	1.08	1.11	1.11	1.11
Met, %	0.44	0.45	0.47	0.47	0.47
Cys, %	0.37	0.37	0.39	0.39	0.39
TSAA, %	0.81	0.82	0.86	0.86	0.86
Trp, %	0.27	0.27	0.28	0.28	0.28
Val, %	1.13	1.15	1.20	1.20	1.20
Ile, %	0.96	0.97	1.02	1.02	1.02
Leu, %	1.96	2.02	2.10	2.10	2.10
Arg, %	1.46	1.48	1.56	1.56	1.56
Ala, %	1.21	1.24	1.30	1.30	1.30
Asp, %	2.33	2.35	2.47	2.47	2.47
Glu, %	3.76	3.82	4.04	4.04	4.04
Gly, %	1.01	1.02	1.07	1.07	1.07
His, %	0.61	0.62	0.64	0.64	0.64
Phe, %	1.11	1.13	1.19	1.19	1.19
Pro, %	1.33	1.34	1.43	1.43	1.43
Ser, %	1.16	1.18	1.24	1.24	1.24
Tyr, %	0.57	0.58	0.63	0.63	0.63

Table H. Phase N3: Experimental Diet Proximate Analyses.

Item	T1	T2	T3	T4	T5
Moisture, %	11.67	11.67	11.67	11.46	11.42
Dry Matter, %	88.33	88.33	88.33	88.54	88.58
CP, %	23.20	23.20	23.20	24.50	23.80
ADF, %	5.80	5.80	5.80	6.20	5.40
Total Digestible Nutrients, %	76.60	76.60	76.60	76.50	77.30
Ca, %	0.89	0.89	0.89	0.77	0.86
P, %	0.50	0.50	0.50	0.51	0.51
K, %	0.93	0.93	0.93	1.00	0.94
Mg, %	0.18	0.18	0.18	0.20	0.20
Zn, ppm	193.60	193.60	193.60	183.20	228.50
Fe, ppm	85.00	85.00	85.00	62.00	77.00
Mn, ppm	62.00	62.00	62.00	56.00	69.00
Cu, ppm	36.10	36.10	36.10	25.10	50.70
S, %	0.26	0.26	0.26	0.26	0.27
Na, %	0.22	0.22	0.22	0.18	0.22
Mo, ppm	0.78	0.78	0.78	0.99	0.82

Table I. Phase N3: Experimental Diet Complete Amino Acid Profiles.

Item	T1	T2	T3	T4	T5
Moisture, %	13.22	13.22	13.22	12.93	12.77
Dry Matter,%	86.78	86.78	86.78	87.07	87.23
CP, %	24.34	24.34	24.34	25.84	24.67
Fat, %	5.97	5.97	5.97	5.76	6.13
Fiber, %	4.04	4.04	4.04	4.35	4.17
Lys, %	1.62	1.62	1.62	1.72	1.65
Thr, %	1.03	1.03	1.03	1.09	1.04
Met, %	0.45	0.45	0.45	0.49	0.46
Cys, %	0.38	0.38	0.38	0.41	0.38
TSAA, %	0.83	0.83	0.83	0.90	0.84
Trp, %	0.25	0.25	0.25	0.27	0.25
Val, %	1.14	1.14	1.14	1.21	1.15
Ile, %	1.00	1.00	1.00	1.07	1.01
Leu, %	2.17	2.17	2.17	2.30	2.17
Arg, %	1.54	1.54	1.54	1.65	1.56
Ala, %	1.36	1.36	1.36	1.44	1.37
Asp, %	2.26	2.26	2.26	2.44	2.29
Glu, %	3.99	3.99	3.99	4.30	4.07
Gly, %	1.02	1.02	1.02	1.09	1.04
His, %	0.62	0.62	0.62	0.67	0.63
Phe, %	1.18	1.18	1.18	1.27	1.20
Pro, %	1.53	1.53	1.53	1.64	1.53
Ser, %	1.19	1.19	1.19	1.27	1.20
Tyr, %	0.66	0.66	0.66	0.71	0.67