



Honduras
Valle del Yeguaré, km 30
carretera de Tegucigalpa a Danlí.
Francisco Morazán, Honduras, C.A.
Tel. (504) 2287-2000 ext. 2001 / 20004
Fax: (504) 2776-6247
zamorano@zamorano.edu

United States
1701 Pennsylvania Ave. NW,
Suite 300.
Washington, DC 20006
Tel: (202) 461-2242
Fax: (202) 580-6559
wdc@zamorano.edu

Final report on the use of MrFeed® Pro50 C in the diets of broiler chicken

According to the agreement signed in 2018 between Escuela Agrícola Panamericana Zamorano (EAP) and Menon Renewable Products, Inc. (MENON), in November 2018 and under the scientific direction of Dr. Valdiviá, this is an experiment with the use of MrFeed® Pro50 C in the diets of broiler chicken.

This experimental work had as a general objective "To evaluate the use of MrFeed® Pro50 C in chicken starter diets (0-10 days) as a promoter of intestinal health and improvement of the zootechnical parameters of the bird and its effect on the complete cycle of production, grower stage (11-22 days) and finishing stage (23-35 days)".

To comply with the general objective, 3024 one-day-old Cobb® broilers were used and the following experimental treatments were prepared: 5% of MrFeed® Pro50 C at the start, 8% of MrFeed® Pro50 C on growth and 11% of MrFeed® Pro50 C in the finisher stage (T1); 5% of MrFeed® Pro50 C at the start (T2); 7.5% of MrFeed® Pro50 C at the start (T3); 10% of MrFeed® Pro50 C at the start (T4); basal diet (T5) and 2.8% MrFeed® Pro50 C + 2.8% fish meal at the start (T6).

Measured variables

In the initial stage (0-10 days), the following parameters were determined: viability, weight of the lymphoid organs, initial and final live weight, feed intake, feed conversion ratio and intestinal health.

In the growth stage (11-22 days), the initial and final live weight were measured. Viability, feed consumption and feed conversion ratio were determined.

In the finisher life stage (23-35 days), the initial and final live weights were measured. Viability, feed intake, feed conversion ratio and weights of the carcass, edible viscera, neck, breast and legs were measured.



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Diets used

Table 1. Diets from 0 to 10 days

Ingredients	T1	T2	T3	T4	T5	T6
Corn meal	57.202	57.202	57.807	59.7208	55.988	60.098
Soybean meal	32.94	32.94	30.14	26.175	38.56	30
Actipal HP (Fish meal)	0	0	0	0	0	2.811
MrFeed® Pro50 C	5.008	5.008	7.503	10	0	2.81
Biofost	1.37	1.37	1.375	1.382	1.36	1.339
Palm oil	0.95	0.95	0.82	0.48	1.21	0.20
Calcium carbonate	1.326	1.326	1.215	1.103	1.547	1.423
Sodium bicarbonate	0.191	0.191	0.171	0.168	0.231	0.204
Salt	0.368	0.368	0.383	0.385	0.338	0.315
Vitamin-mineral premix	0.23	0.23	0.23	0.23	0.23	0.23
DL-methionine	0.15	0.15	0.137	0.13	0.176	0.146
Mycofix Plus	0.12	0.12	0.12	0.12	0.12	0.12
Salinomycin (coccidiostat)	0.05	0.05	0.05	0.05	0.05	0.05
L-lysine	0.051	0.051	0.012	0.0092	0.131	0.2
L-threonine	0.032	0.032	0.025	0.035	0.047	0.042
Natuphos phytase	0.01	0.01	0.01	0.01	0.01	0.01
Olaquinox	0.002	0.002	0.002	0.002	0.002	0.002

Table 2. Diets from 11 to 22 days

Ingredients	T1	T2	T3-	T4	T5	T6
Corn meal	62.918	60.918	60.918	60.918	60.918	60.918
Soybean meal	24.04	33.49	33.49	33.49	33.49	33.49
MrFeed® Pro50 C	8.008	0	0	0	0	0
Biofost	1.227	1.208	1.208	1.208	1.208	1.208
Palm oil	1.4	1.71	1.71	1.71	1.71	1.71
Calcium carbonate	1.095	1.45	1.45	1.45	1.45	1.45
Sodium bicarbonate	0.139	0.118	0.118	0.118	0.118	0.118
Salt	0.322	0.337	0.337	0.337	0.337	0.337



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 Fax: (504) 2776-6247
 zamorano@zamorano.edu

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Vitamin-mineral premix	0.23	0.23	0.23	0.23	0.23	0.23
DL-methionine	0.142	0.18	0.18	0.18	0.18	0.18
Mycofix Plus	0.12	0.12	0.12	0.12	0.12	0.12
Salinomycin (coccidiostat)	0.05	0.05	0.05	0.05	0.05	0.05
L-lysine	0.185	0.132	0.132	0.132	0.132	0.132
L-threonine	0.112	0.045	0.045	0.045	0.045	0.045
Natuphos phytase	0.01	0.01	0.01	0.01	0.01	0.01
Olaquinox	0.002	0.002	0.002	0.002	0.002	0.002

Table 3. Diets from 23 to 35 days

Ingredient	T1	T2	T3-	T4	T5	T6
Corn meal	66.099	62.851	62.851	62.851	62.851	62.851
Soybean meal	17.97	31.326	31.326	31.326	31.326	31.326
MrFeed® Pro50 C	11.007	-	-	-	-	-
Biofost	0.853	0.826	0.826	0.826	0.826	0.826
Palm oil	1.86	2.61	2.61	2.61	2.61	2.61
Calcium carbonate	0.911	1.397	1.397	1.397	1.397	1.397
Sodium bicarbonate	0.119	0.03	0.03	0.03	0.03	0.03
Salt	0.308	0.374	0.374	0.374	0.374	0.374
Vitamin-mineral premix	0.23	0.23	0.23	0.23	0.23	0.23
DL-methionine	0.089	0.14	0.14	0.14	0.14	0.14
Mycofix Plus	0.12	0.12	0.12	0.12	0.12	0.12
Salinomycin (coccidiostat)	0.05	0.05	0.05	0.05	0.05	0.05
L-lysine	0.225	0.026	0.026	0.026	0.026	0.026
L-threonine	0.145	0.0075	0.0075	0.0075	0.0075	0.0075
Natuphos phytase	0.01	0.01	0.01	0.01	0.01	0.01
Olaquinox	0.004	0.002	0.002	0.002	0.002	0.002



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RESULTS OF THE INITIAL STAGE (0-10 DAYS).

Productivity performance

Table 4 shows the growth performance of broilers fed with different inclusion levels of MrFeed® Pro50 C. The experimental diets with MrFeed® Pro50 C did not indicate significant differences ($P>0.05$) between treatments for the initial live weight, feed intake and feed conversion ratio.

However, the final live weight at 10 days was statistically different ($P <0.05$) between treatments T1 and T2 with T4 (10% MrFeed® Pro50 C), the other treatments showed no significant differences ($P>0.05$) among them. Apparently, the highest inclusion with MrFeed® Pro50 C (10%) caused a decrease in live weight after 10 days.

It should be noted that despite the fact that T1 (5%) and T6 (2.8% MrFeed® + 2.8% HP) did not differ statistically with the control diet (T5), a weight difference of 6 and 8 grams was observed, respectively.

The viability showed excellent values that ranged between 98.86% and 99.77% and did not differ statistically between treatments ($P>0.05$) as shown in table 4.

Table 4. Effect of MrFeed® Pro50 C on the productive performance of broilers (0 to 10 days)

Treatments	Productivity performance				
	Initial live weight (g)	Feed intake (g)	Feed conversion ratio (kg/kg)	Final live weight (g)	Viability
T1 (5% MrFeed®)	43.68	227	0.95	238 ^a	98.86
T2 (5% MrFeed®)	43.26	230	0.98	233 ^{ab}	99.77
T3 (7.5% MrFeed®)	43.26	222	0.94	233 ^{ab}	98.86
T4 (10% Mr. Feed)	42.74	222	0.97	228 ^b	98.86
T5 (0% MrFeed®)	43.48	223	0.97	232 ^{ab}	99.09
T6 (2.8% MrFeed®+2.8 % HP)	43.26	232	0.97	240 ^a	99.77
Standard error±	0.50	3.39	0.017	2.97	0.497
P-value	0.885	0.236	0.508	0.038	0.614

^{a, b, c} Different letters in the same column differ significantly at $P <0.05$. Duncan (1995)

Weight of lymphoid organs

Table 5 shows the effect of MrFeed® Pro50 C on the weight of the lymphoid organs of 10-day-old broiler chickens.

The bursa of Fabricius increased ($P < 0.05$) with the T1 and T2 compared to the T3, T4, T5 and T6, thus a greater inclusion with MrFeed® Pro50 C from 7.5% to 10% decreased the weight of this organ. The bursa of Fabricius is a primary lymphoid organ that produces the B lymphocytes. An increase of this organ has been associated with an increase in the immune activity and a better immune response to possible pathogens.

However, the weight of the thymus decreased with the treatments with MrFeed® Pro50 C in correspondence to the basal diet (T5), being more accentuated the decrease in the weight of the organ with the highest inclusion with MrFeed® Pro50 C (10%). The thymus is the other primary lymphoid organ that produces the T lymphocytes. The increase of this organ has been associated to the presence of lactating pathogens and stress conditions. It is noted that these birds showed no symptoms of any disease.

On the other hand, dietary inclusion with MrFeed® Pro50 C up to 7.5% (T1, T2 and T3) increased the weight of the spleen with different statistics ($P < 0.05$) with T4, T5 and T6, showing the lowest values the control or basal diet and the greater inclusion of MrFeed® Pro50 C (T4-10%). Although this organ is considered a secondary lymphoid organ for young birds, it has important immunological activity.

Table 5. Effect of MrFeed® Pro50 C on the weight of the lymphoid organs of broiler chickens at 10 days of age

Treatments	Weights of lymphoid organs		
	Bursa of Fabricius	Thymus	Spleen
T1 (5% MrFeed®)	0.59 ^a	0.64 ^b	0.19 ^a
T2 (5% MrFeed®)	0.58 ^a	0.65 ^b	0.19 ^a
T3 (7.5% MrFeed®)	0.37 ^d	0.48 ^d	0.19 ^a
T4 (10% Mr. Feed)	0.44 ^{bc}	0.50 ^{cd}	0.16 ^c
T5 (0% MrFeed®)	0.43 ^c	0.85 ^a	0.16 ^c
T6 (2.8% MrFeed®+2.8 % HP)	0.48 ^b	0.67 ^b	0.17 ^b
Standard error ±	0.012	0.024	0.005
P-value	<0.001	<0.001	<0.001

a, b, c, d Different letters in the same column differ significantly at $P < 0.05$. Duncan (1995)

Table 6 shows the data of the intestinal morphology analysis of broilers at 10 days of age. In the duodenum, the inclusion in the diet with MrFeed® Pro50 C did not show significant changes in the villi height ($P > 0.05$). However, the use with MrFeed® Pro50 C at 7.5% (T3) increased the crypts depth with significant differences ($P < 0.05$) with the group with 5% MrFeed® Pro50 C (T1).

Similarly, MrFeed® Pro50 C at 7.5% (starter) decreased the ratio between villus height and crypt depth compared to the other treatments ($P < 0.05$). In the jejunum, increasing levels with MrFeed® Pro50 C (T1) per productive phase increased the villi height, being lower in T4, T5 and T6 ($P < 0.05$). Although the crypts depth did not show significant differences between treatments ($P > 0.05$), T4 and T6 indicated the closest ratio in villus height/crypts depth ($P < 0.05$). In Ileum, the experimental treatments did not change the villi height ($P > 0.05$), however, the T6 increased the crypts depth and the villus height/crypts decreased, respectively ($P < 0.05$). Other treatments such as T4 showed results contrary to T6, the crypts depth was reduced and the proportion increased ($P < 0.05$).

Intestinal morphology

Table 6. Effect of MrFeed® Pro50 C on the intestinal morphology of 10-day old broiler chickens

Intestinal morphology metrics	Level of inclusion with MrFeed® Pro50 C						Standard error \pm	P-value
	T1	T2	T3	T4	T5	T6		
<i>Duodenum</i>								
VH	1120	1010	1010	1100	1210	1146	81.75	0.484
CD	100 ^b	108 ^{ab}	142 ^a	124 ^{ab}	116 ^{ab}	122 ^{ab}	12.069	0.024
VH/CD	12.91 ^a	9.27 ^{ab}	7.36 ^c	9.28 ^{ab}	10.55 ^{ab}	9.42 ^{ab}	1.219	0.007
<i>Jejunum</i>								
VH	690 ^a	580 ^{ab}	525 ^{ab}	430 ^b	480 ^b	434 ^b	60.630	0.045
CD	100	106	100	130	94	118	19.732	0.796
VH/CD	7.23 ^a	5.73 ^{ab}	5.33 ^{ab}	4.43 ^b	5.11 ^{ab}	3.81 ^b	0.819	0.015
<i>Ileum</i>								
VH	375	350	270	320	350	290	32.096	0.212
CD	88 ^{ab}	80 ^{abc}	76 ^{bc}	64 ^c	84 ^{abc}	102 ^a	7.257	0.029



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VH/CD	4.29 ^{ab}	4.48 ^{ab}	3.64 ^{bc}	5.18 ^a	4.29 ^{ab}	2.89 ^c	0.428	0.019
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a, b, c, d Different letters in the same column differ significantly at $P < 0.05$. Duncan (1995)

VH: Villi height; CD: Crypts depth

It has been reported that the villous and crypt morphology has been associated with intestinal health and the growth performance of animals. In the jejunum, where nutrient uptake occurs mainly, the dietary inclusion with MrFeed® Pro50 C (mainly T1) modified the villi height (VH) and the crypts depth (CD), with differences with the basal diet or control (T5) ($P < 0.05$).

In addition, in the duodenum and ileum, this treatment (T1) increased the ratio between VH:CD. A reduction of the villi and crypts produces less absorption cells and more secretory cells. The migration of specialized cells to the villi would raise the crypts depth. Understanding the relationship between the villi and the crypt is useful for estimating the digestion of nutrients and the absorption capacity of the small intestine. The higher the proportion of villi/crypts, the greater the efficiency in the digestive process.

Conclusions in the starter stage (0-10 days)

- Under the conditions of excellence that exist in the Poultry Research and Teaching Center of the EAP-Zamorano for raising broilers, the viability was excellent and did not differ between treatments with or without MrFeed® Pro50 C.
- The inclusion with 5% MrFeed® Pro50 C in the starting diets (0 to 10 days of age) for the broilers promoted a greater development of the bursa of Fabricius and the spleen, which evidenced an increase in the immunity.
- The use of MrFeed® Pro50 C had no effect on feed intake and feed conversion ratio.
- Dietary inclusion with 5% MrFeed® Pro50 C and 2.5% MrFeed® Pro50 C + fishmeal promoted the live weight of the birds.
- Live weight at 10 days of age did not differ between treatments containing 0%, 2.8%, 5%, and 7.5% of MrFeed® Pro50 C.
- The use of MrFeed® Pro50 C in the diets of broiler chickens improved intestinal health compared to the basal diet (T5), mainly with the inclusion of 5% of MrFeed® Pro50 C.



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RESULTS OF THE GROWER STAGE (11-22 DAYS, 0-21 DAYS).

The effect of the dietary use of MrFeed® Pro50 C in broilers from 11 to 22 days is shown in table 7. No significant differences ($P>0.05$) were observed between treatments in this productive stage for any measured indicator.

Similar was found when the productive performance of the birds was calculated from 0 to 21 under a diet with levels of MrFeed® Pro50 C (Table 8).

Table 7. Effect of MrFeed® Pro50 C on the growth performance of broilers (11-21)

Treatments		Indicators			
MrFeed® 0 - 10 days	MrFeed® 11 – 21 days	Viability (%)	Feed intake (g)	Feed conversion ratio (kg/kg)	Live weight at 21 days (g)
T1 (5%)	(8%)	98.86	785	1.19	903
T2 (5%)	(0%)	99.77	827	1.23	904
T3 (7.5%)	(0%)	98.86	759	1.14	907
T4 (10%)	(0%)	98.86	773	1.15	897
T5 (0%)	(0%)	99.09	780	1.20	884
T6 (2.8% +HP)	(0%)	99.55	814	1.20	918
Standard error ±		0.44	43	0.27	14
P-value		0.614	0.081	0.062	0.439

Although no significant differences were found from the bio-statistical point of view due to the variability of the data, the use of MrFeed® Pro50 C improved the live weight of the birds by 34 grams (T6) compared to the basal treatment, as well as the T3 with 7.5% with MrFeed® Pro50 C reduced feed intake by 21 grams.

Also, in the period of 0-21 days, it is observed that the feed intake decreased with 7.5% MrFeed® Pro50 C, which corresponds with the control diet (T5) in 17 grams, this treatment being the one with the lowest feed conversion ratio.



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 wdc@zamorano.edu

Table 8. Effect of MrFeed® Pro50 C on the growth performance of broilers (0-21)

Treatments		Indicators			
MrFeed® 0 - 10 days	MrFeed® 11 – 21 days	Viability (%)	Feed intake (g)	Feed conversion ratio(kg/kg)	Live weight at 21 days (g)
T1 (5%)	(8%)	98.86	1017.88	1.13	902.50
T2 (5%)	(0%)	99.77	1063.00	1.18	904.00
T3 (7.5%)	(0%)	98.86	986.75	1.08	907.13
T4 (10%)	(0%)	98.86	1004.13	1.12	896.88
T5 (0%)	(0%)	99.09	1003.00	1.13	883.75
T6 (2.8% +HP)	(0%)	99.55	1046.88	1.14	926.50
Standard error ±		0.440	26.080	0.054	918.38
P-value		0.614	1017.88	1.13	13.990

Conclusions in the grower stage (11-22 days, 0-21 days)

- Dietary employment with MrFeed® Pro50 C did not statistically modify the growth performance until 21 days of age of the broilers.

RESULTS OF THE FINISHER STAGE (23-35 DAYS; 0-35 DAYS).

Table 9 reflects the growth performance of broiler chicks in the finisher stage fed with MrFeed® Pro50 C levels.

Table 9. Effect of MrFeed® Pro50 C on the growth performance of broilers (21-35 days)

Treatments		Indicators			
MrFeed® 0 - 10 days	MrFeed® 23 - 35 days	Viability (%)	Feed intake (g)	Feed conversion ratio (kg/kg)	Final live weight (g)
T1 (5%)	(11%)	100	2279	1.82^b	1257
T2 (5%)	(0%)	100	2417	2.02 ^a	1203
T3 (7.5%)	(0%)	100	2404	2.02 ^a	1194
T4 (10%)	(0%)	99.55	2280	1.94 ^a	1182
T5 (0%)	(0%)	100	2418	2.01^a	1203
T6 (2.8% + HP)	(0%)	99.77	2334	1.99 ^a	1173



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Standard error ±	0.19	51	0.04	34
P-value	0.890	0.420	0.018	0.480

a, b Different letters in the same column differ significantly at P <0.05. Duncan (1995) 1: 2.8% Mr. Feed + 2.8% HP at the start)

The viability from 21 to 35 days was excellent (99.55 to 100%) and did not differ (P>0.05) between treatments. No significant differences were detected (P>0.05) between the treatments for feed intake from 21 to 35 days and for the live weight gain from 21 to 35 days of age (Table 9).

However, at this stage from 21 to 35 days of age, treatment with 5%, 8% and 11% with MrFeed® Pro50 C in the start, growth and finishing diets, respectively, improved the feed conversion ratio. Apparently, the continued and progressive use of the MrFeed® feed product promotes better feed efficiency (Table 9).

Table 10. Effect of MrFeed® Pro50 C on the growth performance of broilers (0-35 days)

Treatments		Indicators				
MrFeed® 0 - 10 days	MrFeed® 23 – 35 days	Viability (%)	Initial live weight (g)	Feed intake (g)	Feed conversion ratio (kg/kg)	Final live weight (g)
T1 (5%)	(11%)	98.41	43.68	3297	1.53^a	2160
T2 (5%)	(0%)	99.55	43.26	3480	1.65 ^b	2107
T3 (7.5%)	(0%)	98.18	43.26	3416	1.63 ^b	2100
T4 (10%)	(0%)	97.50	42.74	3284	1.58 ^{ab}	2078
T5 (0%)	(0%)	98.64	43.48	3421	1.64 ^b	2087
T6 (2.8% +HP)	(0%)	98.64	43.26	3381	1.62 ^b	2090
Standard error ±		0.59	0.50	93	0.03	37
P-value		0.901	0.885	0.524	0.048	0.586

a, b Different letters in the same column differ significantly at P <0.05. Duncan (1995)

The total viability ranged between 97.50 and 99.55%, without statistical differences between treatments (P>0.05), which shows that the use of MrFeed® Pro50 C at levels of 0, 2.8, 5, 7.5 and 10% in the starting diets of broilers and of 5, 8 and 11% in the starter, growth and finishing diets, respectively, had no harmful influence on the viability of the broiler chickens



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during the 35 total days of rearing. It is emphasized, that the viability values are excellent and coincide in the manual of the genetic line.

Table 10 shows that the feed intake did not differ ($P > 0.05$) between the treatments with MrFeed® Pro50 C and its control without MrFeed® Pro50 C. The final live weight of the chicks at 35 days of age did not differ significantly ($P > 0.05$) between treatments and ranged between 2078 and 2160 g/chicken.

The best total feed conversion ratio was obtained with the treatment in which MrFeed® Pro50 C was used at levels of 5%, 8% and 11% in the starter, grower and finishing diets, respectively, which showed that the use of MrFeed® Pro50 C at increasing levels in the diets according to the productive stage significantly improves the feed efficiency of the nutrients of the classic corn-soybean diets.

Weights of the carcass, components of the carcass, and edible viscera

Table 11 shows the data of carcass weight, edible viscera weight, neck weight, breast weight and leg weight at 35 days of age.

Table 11. Effect of MrFeed® Pro50 C on the carcass traits of broiler chicken (35 days)

Treatments		Indicators				
MrFeed® 0 - 10 days	MrFeed® 23 - 35 days	Carcass weight (g)	Edible viscera weight (g)	Neck weight (g)	Breast weight (g)	Leg weight (g)
T1 (5%)	(11%)	1466 ^a	80	79 ^b	550 ^a	449
T2 (5%)	(0%)	1439 ^{ab}	77	79 ^b	508 ^b	449
T3 (7.5%)	(0%)	1441 ^{ab}	80	77 ^b	481 ^c	462
T4 (10%)	(0%)	1427 ^{bc}	80	95 ^a	490 ^{bc}	454
T5 (0%)	(0%)	1453 ^a	79	71 ^b	502 ^{bc}	452
T6 (2.8% +HP)	(0%)	1400 ^c	82	79 ^b	496 ^{bc}	444
Standard error ±		3.7	1.9	3.8	8.3	7
P-value		0.001	0.682	0.002	0.001	0.543

a, b, c Different letters in the same column differ significantly at $P < 0.05$. Duncan (1995)



Honduras
Valle del Yeguaré, km 30
carretera de Tegucigalpa a Danlí.
Francisco Morazán, Honduras, C.A.
Tel. (504) 2287-2000 ext. 2001 / 20004
Fax: (504) 2776-6247
zamorano@zamorano.edu

United States
1701 Pennsylvania Ave. NW,
Suite 300.
Washington, DC 20006
Tel: (202) 461-2242
Fax: (202) 580-6559
wdc@zamorano.edu

The highest carcass weights were achieved with the treatment containing MrFeed® Pro50 C at levels of 5, 8 and 11% in the starter, grower and finisher diets, respectively, and with the basal diet. The worst result was observed with the inclusion of 2.8 + HP (T6).

The breast is the component of the carcass with white meat, with higher meat content, and higher price in the international market. Thus the T1 with inclusion levels of 5, 8 and 11% of MrFeed® Pro50 C in the starter, grower and finisher, respectively, promoted a greater weight of the carcass with respect to the basal diet. It is noted that the greater weight of the breast has been associated with greater intestinal health, which influences the digestion and absorption of nutrients, mainly lysine.

Also, in table 11 it can be seen that the weight of the legs did not differ between treatments, the same as the weight of the edible viscera (heart + liver + gizzard).

Conclusions in the finisher stage (22-35 days, 0-35 days)

- MrFeed® Pro50 C is an innocuous feed for broilers, with which high viability is achieved (97.50 to 99.55%) and does not alter feed intake and live weight of the birds, when it is included up to levels of 11% in the diets during 35 days of age.
- The use of MrFeed® Pro50 C at levels of 5%, 8% and 11% in the starting, growing and finishing diets, respectively, improves the feed efficiency in classic corn-soy diets for chickens during finisher stage.
- The use of MrFeed® Pro50 C at levels of 5%, 8% and 11% in the starter, grower and finisher diets, respectively, promotes heavier breasts at 35 days of age of the broilers, which indicated that it works as an enhancer of the muscle deposition in the breast.

End of report

A handwritten signature in black ink, appearing to read "Yordan Martínez Aguilar".

Yordan Martínez Aguilar Ph.D.
Profesor Asociado en Nutrición Animal y Producción Avícola
Departamento Ciencia y Producción Agropecuaria
Escuela Agrícola Panamericana Zamorano.