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Behavior of Productive Indicators in Two Female Broiler Lines Using Two Feeding Systems in Tropical Environmental Conditions

Hugo Javier Alvarado Álvarez; Luis Domingo Guerra Casas**; Roberto Vázquez Montes de Oca**; Ángel Eduardo Ceró Rizo**; Juan Carlos Gómez Villalva*; Enrique Gallón Valverde**

*** Faculty of Agricultural Sciences, Technical University of Babahoyo, Ecuador**

**** Ignacio Agramonte Loynaz University of Camagüey, Cuba**

halvarado_mvz@hotmail.com

ABSTRACT

To study the behavior of weekly weight, food consumption, and foodd conversion associated to meat production in female broilers in the tropics, 400 one-day old female broilers (200 Ross 308 and 200 Cobb 500 broilers) were included in an experiment. Breeding was made in two houses with uncontrolled environmental conditions. A multifactorial design was used; including lines (Cobb 500 and Ross 308), food presentation (meal and pellets), and two houses, for a base design of eight combinations of factors and a repetition, totaling N=16 quarters. The experimental unit was made of 25 female broilers in each quarter, with a density of 12 chicken/m^2, similar to the usual local production conditions. Simple and multiple analyses of variance were made with interactions and analysis of covariance. The values achieved for the weekly weights, food consumption, and food conversion were adequate for the production conditions of female broilers in the tropic, and similar to reports of yielding manuals for the lines studied.

Key words: *feeding, broilers, lines, productivity*

INTRODUCTION

Nowadays, intensive broiler chicken breeding is influenced by factors like animal genetic improvements in terms of growth speed, food conversion, and intensive breeding caused by an increased population on the farm, which requires better management (Parra, Parra, and Urdaneta, 2017).

The growing demand of poultry in the world originated by production costs and markets has created huge gaps in consumption habits where consumer preferences are based on the purchasing power.

The fast growing broilers Cobb 500 and Ross 308 lines have a significant effect on the productive behavior of poultry. These lines have demonstrated a high capacity to adapt to the environmental conditions of the Ecuadoran Amazon region (Andrade, Toalombo, Andrade, and Lima, 2017).

The growth of the broiler chicken industry in South America has been important for the region in recent years. Today, more than 9.430 million broiler chicken are slaughtered in South America, with Brazil, Argentina, and Colombia leading the production in the region. Broiler chickens are raised in different types of sheds, particularly by integrated companies (Bueno, López, Rodríguez, and Procura, 2016).

The production of broiler chickens, especially males, has developed and spread out in all climates and regions due to their high adaptability, cost-effectiveness, market acceptance, and availability of breeds with excellent productive behavior and food conversion. The aim of this paper was to evaluate the behavior of weekly weight, food consumption, and food conversion.

MATERIALS AND METHODS

This study was conducted on *San Pablo* Experimental Farm, owned by Faculty of Agricultural Sciences, Technical University of Babahoyo, province of Los Rios, Ecuador, km 7.5, Babahoyo-Montalvo highway. The area is located 01º 47” 49” south latitude, and 79º 32” west longitude. The annual precipitation is 2 791,04 mm, with an average temperature of 25 ºC and a relative humidity of 76%; 7.5 meters above sea level.

Animals

The total number of broiler animals included in the study was 400 (200 from Cobb 500 and 200 from Ross 308). They were distributed in 16 quarters, each consisting of 25 animals.

Feeding

Commercial pellets and meal (BIOALIMENTAR) were used during three phases (start, growth, finishing).

Houses

East-west oriented, open houses (15 m long by 5 m wide), with a capacity of 750 broiler chickens (10 chickens/m²). A 50 cm high wall made of bricks and concrete surrounds the house, which is covered with a 2.5 m high grid of welded rods, from the floor to the lowest roof point, and 5 m from the middle of the house to the highest point, with a ventilator across the house.

Experimental design

A multifactorial design was used for lines (Cobb 500 and Ross 308), food presentation (meal and pellets), and two houses, for a base design of eight combinations of factors and a repetition, totaling N=16 quarters. The experimental unit was made of 25 female broilers in each quarter, with a density of 12 chicken/m^2, similar to the usual local production conditions.

Statistical analysis

All the data were recorded and processed by IBM SPSS, version 23. Analysis of multiple variance with interactions, and analysis of covariance were performed. The variables studied were weekly weight, consumption of foods, and food conversion.

Each model included the main effects of the house, line, type of food and their second order interactions, and co-variables initial weight and quarter temperature (morning, afternoon, and evening). Finally, each model was adjusted according to the statistically significant effects observed.

RESULTS AND DISCUSSION

Table 1 shows the significant results for the main effects of the factors studied and the house * type of food interaction, the only significant interaction. Likewise, the table shows the degrees for freedom error, the potency ranges of statistical test (lower and upper limits), and the coefficient of determination. These quality indicators for the model indicated the efficacy of the statistical and experimental controls made.

Regarding weights, after six weeks ($P<0.001$), the effects of type of food in the first three weeks, house-type of food interaction in the first week, and house in the fourth week, were all significant. Also, the effects of house for the first week, the type of food for the fifth week, and the house-type of food interaction in weeks two and three, were significant ($P<0.01$) for weights.

Finally, regarding weight, the effect of house in the second and third weeks were significant ($P<0.05$), as well as the type of food in the fourth week. The other effects did not show any significant differences for this variable in any week.

The table also shows the results for food consumption and food conversion, as they were expressed in the weight variable. The effects of type of food on food consumption were significant ($P<0.001$) in the third, fourth, fifth, and sixth weeks, and on food conversion in all the weeks. Additionally, he effects of house for the first and third weeks and house-type of food interaction on food consumption for the first week, were significant ($P<0.01$). The effect of house in the third and fourth weeks was highly significant ($P<0.001$) for variable food conversion.

The effect of line was not significant in any of the models used for each variable in all the weeks, which indicated similar results for the two lines used in the study. In the sixth week, the effect of weight showed no statistical significance; therefore, it was not included in the table. No influence of the co-variables (initial weight and temperatures) was observed, so the models were rendered as simple and multiple ANOVA with interactions.

Table 2 shows the values for the estimated means of the variables in the study for the significant effects (type of food, houses, and interaction). The pellet variant always presented higher means in the first three weeks for the weekly weight variable; the means estimated were 180, 498, and 876 for the first, second, and third weeks, respectively.

Morales and Murillo (2016) reported mean values of 160-176 g in the first week, using pellets in both sexes, with a density of 8 and 10 chickens per m². In this research, the results are lower for the meal type of food, but higher for the pellets. In the second week, the behavior according to the reports of the previous authors was similar to the results for the first week and slightly higher for the third week.

Zambrano, Gómez, Rodríguez, Alvarado and Quezada (2017), using a traditional breeding system in Ecuador, with different levels of manane oligosaccharides (MOs), achieved weights of 165.24, 421.07, and 799.78 g in the first three weeks, respectively, which were inferior to the results of this work.

The weight values achieved were also higher than the reports of Tolentino, Icochea, Reyna, and Valdivia (2008), in the first three weeks. They evaluated the influence of air temperature and humidity on the productive parameters of broilers (Cobb-Vantress 500).

An analysis of food consumption and food conversion showed that the pellet type of food was more effective than the meal in the third week. The type of food-house interaction only showed significant differences for meal in house No. 2, in the second week, with means of 643 g for house No. 2, and 591 g for house No. 1.

Food conversion showed no significant differences for any of the effects studied, which were lower than the 2.09 and 2.16 reported by Parra, Parra, and Urdaneta (2017).

Zambrano *et al.* (2017) reported food conversion values of 0.84, 0.81 and 1.33 for the first, second, and third weeks, respectively, using manane oligosaccharides to fatten chicken. These values were lower than the present study, considered as the mean of the lowest value for meal, and highest for pellets, in every week.

Table 3 shows the results of the effects studied: type of food, house, and their interaction, on the weekly weight, food consumption, and food conversion variables, in the fourth, fifth, and sixth weeks.

Significant differences for feeding were observed for weights toward house No. 2. Significant differences were also observed in the fifth week, with higher values for pellets. No significant differences were observed for any of the effects studied in the sixth week due to the adaptation of animals to the environmental conditions, management, and feeding.

Valenzuela, Carvallo, Morales, and Reyes (2015) determined the effect of dried ensilage of salmon in the diet of broiler chickens on the productive parameters and sensorial quality of meat. They reported 2 264 g in the sixth week, higher than the results of the current paper for the weight variable (Table 3). As to food consumption, they achieved 6 304 g/total in 42 days, higher than the values in Table 3.

In that sense, only the type of food showed significant differences in the three weeks, which contrasted with food conversion, with a similar behavior to the type of food, but significant differences for houses in the fourth week.

Valdivié, Rodríguez, and Dieppa (2004) used two Cuban crossbred types (broiler HEEB55 and Lohmann), in low (10 chickens chickens/m^2) and high (25 chickens/m^2) densities during the summer, and reported food conversion values of 1.94 and 1.92, respectively, on the forty-second day, slightly lower than the values found in this work.

A comparison of the results in Tables 2 and 3 with the breeding manuals of companies that supply Ross 308 (Aviagen, 2014) and Cobb 500 (Cobb-Vantress, 2014), revealed the following:

- In Table 2, for the first week, the weekly weight was similar to the 188 g for Ross 308, and slightly lower than Cobb 500, which weighed 184 g.
- Consumption during the first week was lower than Ross 308 and Cobb 500.
- The food conversions shown in Table 2 varied between 0.85 and 0.94 kg of food/kg of LW, similar to the above-mentioned values for Ross 308 and Cobb 500.
- In the same table, for the second week, weights varied between 421 and 498 g, similar to the previously cited manuals.
- The food consumption variable showed higher values in comparison to the breeding manuals for Cobb 500 (468 g) and Ross 308 (462 g). These manuals report food conversion indexes of 1.17 and 1.12 for both lines, respectively, which are below the values in Table 2.
- In the third week, the food consumption variable was 728 g (Ross 308), and 721 g (Cobb 500), which were lower than the values shown in Table 2.
- Weight in the third week showed similar values to Ross 308, but lower than Cobb 500. As to food conversion, the values observed for the lines studied were within the range of this research (1.22-1.47).

The manuals for the lines studied suggest weekly weight, food consumption, and food conversion standards of 1 427 g, 2 006 g, and 2 595 g in the fourth, fifth, and sixth weeks, respectively. The values for Ross 308 were higher than the values in Table 2. A similar behavior was observed when the values for Cobb 500 were compared. The results of food consumption and food conversion in the above-mentioned manuals had better behaviors for the last three weeks than the results shown in Table 3. Although in the manuals, the values for the lines corresponded to the sex of this study, the environmental conditions were better than the tropical conditions in which the study took place.

CONCLUSIONS

The values achieved for the weekly weights, food consumption, and food conversion in the six weeks, were adequate for production of female broilers (Ross 308 and Cobb 500) in tropical conditions.

The impact of the effects studied decreased ontogenically due to the adaptation of chickens to tropical conditions.

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Table 1. Results of analysis of variance of the model for the variables and effects studied

Variables	Main effects			House* type of food	Gl error	Potency (%)		R^2 (%)
	House	Type of food	Line			Lower limit	Upper limit	
Weight week 1 (7 Days)	**	***	-	***	12	97	100	94
Weight week 2 (14 Days)	*	***	-	**	12	76	100	86
Weight week 3 (21 Days)	*	***	-	**	12	83	100	78
Weight week 4 (28 Days)	***	*	-	-	13	62	99	70
Weight week 5 (35 Days)	-	**	-	-	14	81	81	40
Food consumption week 1	**	*	-	**	12	66	92	73
Food consumption week 2	-	-	-	***	14	90	100	89
Food consumption week 3	**	***	-	-	13	90	100	75

Food consumption week 4	-	***	-	-	14	100	100	70
Food consumption week 5	-	***	-	-	14	54	99	79
Food consumption week 6	-	***	-	-	14	100	100	72
Food conversion week 1	-	***	-	-	14	100	100	73
Food conversion week 2	-	***	-	-	14	100	100	82
Food conversion week 3	**	***	-	-	13	96	100	88
Food conversion week 4	***	***	-	-	13	99	100	85
Food conversion week 5	-	***	-	-	14	100	100	85
Food conversion week 6	-	***	-	-	14	100	100	68

*** P <0.001; ** P<0.01; * P<0.05

Table 2. Estimated means and variable estimation errors for significant effect (weeks 1, 2, and 3).

Week	Effect	Weekly weight		Food consumption (g)		Food conversion (kg)	
		Mean	TE	Mean	TE	Mean	TE
1	Meal	154	1.6	145	3.70	0.94	0.01
	Pellets	180	1.6	153	3.70	0.85	0.01
	House No 1	172	1.6	154	2.18	-	-
	House No 2	162	1.6	143	2.18	-	-
	Ml* house No. 1	154	2.2	144	5.24	-	-
	Ml* house No. 2	155	2.2	145	5.24	-	-
	Plt* house No. 1	190	2.2	156	5.24	-	-
	Plt* house No. 2	170	2.2	149	5.24	-	-
2	Meal	421	7.1	-	-	1.47	0.02
	Pellets	498	7.1	-	-	1.22	0.02
	House No 1	445	7.1	-	-	-	-
	House No 2	474	7.1	-	-	-	-
	Ml* house No. 1	391	10.1	574	7.79	-	-
	Ml* house No. 2	452	10.1	643	7.88	-	-
	Plt* house No. 1	499	10.1	637	8.22	-	-
	Plt* house No. 2	496	10.1	591	7.71	-	-
3	Meal	749	14.9	1 269	26.3	1.86	0.05
	Pellets	876	14.9	1 386	26.3	1.45	0.05
	House No 1	779	14.9	-	-	-	-
	House No 2	845	14.9	-	-	-	-
	Ml* house No. 1	716	18.2	-	-	-	-

	Ml* house No. 2	782	18.2	-	-	-	-
	Plt* house No. 1	843	18.2	-	-	-	-
	Plt* house No. 2	909	18.2	-	-	-	-

Ml: meal; Plt; pellets

Table 3 Results of the means studied for the weekly weight, food consumption, and food conversion variables, in the fourth, fifth, and sixth weeks

Week	Effect	Weekly weight		Food consumption		Food conversion	
		Mean	TE	Mean	TE	Mean	TE
4	Meal	1 151	18.6	2 341	31.9	2.05	0.05
	Pellets	1 215	18.6	2 096	31.9	1.73	0.05
	House No 1	1 118	18.6	-	-	0.79	0.035
	House No 2	1 247	18.6	-	-	0.72	0.035
	Ml* house No. 1	1 086	22.8	-	-	-	-
	Ml* house No. 2	1 279	22.8	-	-	-	-
	Plt*house No. 1	1 151	22.8	-	-	-	-
	Plt* house No. 2	1 279	22.8	-	-	-	-
5	Meal	1 642	14.2	3 393	34.2	2.08	0.02
	Pellets	1 704	14.2	3 121	34.2	1.82	0.02
	House No 1	1 669	14.2	-	-	-	-
	House No 2	1 677	14.2	-	-	-	-
	Ml* house No. 1	1 621	20.0	-	-	-	-
	Ml*house No. 2	1 662	20.0	-	-	-	-
	Plt* house No. 1	1 716	20.0	-	-	-	-
	Plt* house No. 2	1 692	20.0	-	-	-	-
6	Meal	2 129	18.2	4 526	48.2	2.13	0.02
	Pellets	2 081	18.2	4 117	48.2	1.98	0.02
	House No 1	2 130	18.2	-	-	-	-
	House No 2	2 080	18.2	-	-	-	-

Ml* house No. 1	2 149	25.7	-	-	-	-
Ml* house No. 2	2 109	25.7	-	-	-	-
Plt* house No. 1	2 112	25.7	-	-	-	-
Plt* house No. 2	2 050	25.7	-	-	-	-

Ml: meal; Plt; pellets