HUSBANDRY AND NUTRITION

Productive Performance of Fattening Indicators in Two Broiler Lines, at Three Different Stocking Densities, in the Area of Babahoyo

Hugo Javier Alvarado Álvarez; Luis Domingo Guerra Casas**; Roberto Vázquez Montes de Oca**; Ángel Eduardo Ceró Rizo**; Jorge Luis Sánchez Palomino**

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

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

halvarado_mvz@hotmail.com

DOI: https://doi.org/0000-0002-4400-5941

ABSTRACT

Background: The aim of this paper was to evaluate the performance of fattening in two broiler lines, at different stocking densities, in the area of Babahoyo.

Methods: A total of 300 one-day old Ross 308 and Cobb 500 (150 in every line) broiler males were part of the experiment, which was conducted in an open-sided house, using a multivariate design. The factors studied were, lines, food presentation (meal and pellets), and stocking densities (12, 13, and 14 chicken/m^2). The experimental unit comprised 25 animals. The main effects on covariable starting weight were analyzed.

Results: Regarding weight, the three factors were significant, except line in week 2, and feeding in weeks 5 and 6, whereas stocking density was significant only in week 4. Regarding weekly consumption, line was significant in weeks 4 and 6, feeding in all the weeks, except weeks 5 and 6, whereas stocking density was significant only in week 4. Regarding food conversion, line was significant in weeks 3 and 6, feeding in week 3, and stocking density was not significant at all.

Conclusions: The two lines showed a similar productive performance at 42 days. The final weights achieved were adequate, and food conversion was efficient, thus demonstrating the feasibility of increasing the number of broilers in the sheds under tropical conditions, using meal to cut down production costs.

Key words: *Broilers, line, pellets, meal, food conversion, stocking densities*

INTRODUCTION

In the last decade meat production increased in approximately 20%, most of which was assumed by the poultry industry. The estimates are that by 2024, chicken will cover more than half of the global meat production. In addition to the fact that this type of meat is produced in a short faster time, generating higher profit, the industry is working on genetic breeding, health, and management systems with increasing results (Bueno, López, Rodríguez, and Procura, 2016).

In Ecuador, the largest poultry producing farm is Ponaca, with approximately 116 million chickens a year, then San Isidro Farm, with 36 million chickens a year. These farms use the two lines of chicken (Ross 308 and Cobb 500), due to high adaptability to the country's climate, their availability, speed, and acceptance in the market (Bueno, López, Rodríguez, and Procura, 2016).

This work uses stocking densities above 12 chicken/m^2, which has been studied under the same conditions and positive results, according to Alvarado *et al.* (2018), in this journal. Accordingly, the aim of this paper was to evaluate the productive performance of fattening in two male broiler lines at different stocking densities, in the area of Babahoyo.

MATERIALS AND METHODS

Location

The experimental work was done at the Technical University of Babahoyo, in land belonging to San Pablo experimental facility, in the agricultural production laboratories located in canton Babahoyo, km 7.5, Babahoyo-Montalvo Road, Province of Los Rios, Ecuador. The geographical coordinates are 01º 47"

49" south latitude, and 79º 32" west longitude, 7 m above sea level. The climate is tropical humid, with a mean annual temperature of 25 ºC. The annual precipitation is 1 996.74 mm, and the relative humidity 76%.

Genetic material

Overall, 300 one-day old, Ross 308 (150) and Cobb 500 (150) male broilers were used.

Factors studied

- Broiler lines
- Stocking density (12; 13; 14 chickens/m^2)
- Food presentation (meal and pellets)

Experimental design

A multifactorial design was applied, in which every experimental unit comprised 25 chickens. SPSS, version 23 was used for covariance analysis, using starting weight as covariable, and the Tukey's test ($P<0.05$) for comparisons pf means.

Response variables

- Weight
- Food consumption
- Food conversion

Estimation and construction of experimental units

The experimental sections were made after calculating the dimension, based on the stocking density, according to the functions below:

$$\text{Stocking density} = \frac{12 \text{ chickens}}{25 \text{ chickens}} \times \frac{1 m^2}{?}$$ Then, 25 x 1 / 12 = 2.08 m^2

$$\text{Stocking density} = \frac{13 \text{ chickens}}{25 \text{ chickens}} \times \frac{1 m^2}{?}$$ Then, 25 x 1 / 13 = 1.92 m^2

$$\text{Stocking density} = \frac{14 \text{ chickens}}{25 \text{ chickens}} \times \frac{1 m^2}{?}$$ Then, 25 x 1 / 14 = 1.79 m^2

Then, the dimensions of the area were calculated, 1.10 m wide, to make proper chicken and trough handling. Length was calculated as follows:

$$\text{Length} = \frac{\text{Area}}{\text{Width}}$$

$\frac{2.08 m^2}{1.10 m}$ = 1.89 m in the 12-chicken stocking density /m^2

$\frac{1.92 m^2}{1.10 m}$ = 1.74 m in the 13-chicken stocking density /m^2

$\frac{1.79 m^2}{1.10 m}$ = 1.62 m in the 14-chicken stocking density /m^2

RESULTS AND DISCUSSION

Significantly, the starting weight did not show any significant differences in any of the response variables in the experiment, thus indicating the homogeneity of chickens in each group, and between groups at the beginning of the experiment.

Table 1 shows the significance results of the main effects of factors included in any of the variables studied. As to weight, the three factors were significant, except line in week 2, and feeding in weeks 5 and 6, whereas stocking density was significant only in week 4; it was not significant during the last two weeks. Therefore, the effect of this factor did not change the possible use of any of the three units studied (12, 13, and 14 chicken/m^2). Regarding weekly consumption, line was significant in weeks 4 and 6, and feeding was significant in all the weeks, except weeks 5 and 6; whereas stocking density was significant only in week 4. The effect of the factors on accumulated consumption and food conversion, was significant in the line, in weeks 3 and 6, feeding in week 3, whereas stocking density was not significant at all. These results showed the variable effect of factors by week, with the greatest effect observed in the type of food.

Table 1. Significance of the principal effects (line, feeding, and stocking density) on the variables studied throughout the six weeks

Dependent variable	Line	Feeding	Stocking density
Weight week 1	*	*	Ns
Weight week 2	NS	*	Ns
Weight week 3	*	*	Ns
Weight week 4	*	*	*
Weight week 5	*	Ns	Ns
Weight week 6	*	Ns	Ns
Food consumption week 1	Ns	*	Ns
Food consumption week 2	Ns	*	Ns
Food consumption week 3	Ns	*	Ns
Food consumption week 4	*	*	*
Food consumption week 5	Ns	Ns	Ns
Food consumption week 6	*	Ns	Ns
Accumulated food consumption week 1	Ns	Ns	Ns
Accumulated food consumption week 2	Ns	*	Ns
Accumulated food consumption week 3	Ns	*	Ns
Accumulated food consumption week 4	Ns	*	Ns
Accumulated food consumption week 5	*	Ns	Ns
Accumulated food consumption week 6	*	*	Ns
Food conversion week 1	Ns	Ns	Ns
Food conversion week 2	Ns	Ns	Ns
Food conversion week 3	*	*	Ns
Food conversion week 4	Ns	Ns	Ns
Food conversion week 5	Ns	Ns	Ns
Food conversion week 6	*	Ns	Ns

ns (not significant), * (significant differences for $P < 0.5$)

Table 2 shows the mean, typical error, and significance of factors by week of variable live weight.

Table 2. Performance of the main effects on weight during the six weeks of the experiment

Weight (g)	Lines (Mean)		Feeding (Mean)		Stocking density chicken/m^2 (Mean)		
	Ross 308	Cobb 500	Meal	Pellets	12	13	14
Week 1	235. 2[a]	223.8[b]	222.3[a]	236.8[b]	229.1	232.6	226.9
Typical error	± 4.20		± 3.67		± 6.15		
Week 2	517.7	515.9	494.1[a]	539.5[b]	538.0[a]	510.2[ab]	502.3 [b]
Typical error	± 6.00		± 8.49		± 14.36		
Week 3	1034.5[a]	980.5[b]	957.9 [a]	1057.2 [b]	1037.4	1001.3	983.9
Typical error	± 27.2		± 19.06		± 35.79		
Week 4	1596.1[a]	1494.9[b]	1513.9 [a]	1577.0 [b]	1607.5[a]	1521.4[ab]	1507.5 [b]
Typical error	± 28.28		± 33.02		± 37.53		
Week 5	2321.2[a]	2194.5[b]	2201.1[a]	2314.6[b]	2311.5	2244.5	2217.6
Typical error	± 37.92		± 39.95		± 54.09		
Week 6	2933.6[a]	2791.7[b]	2813.53	2911.73	2957.1	2825.4	2805.4
Typical error	± 49.55		± 54.36		± 61.42		

a, b: Unequal letters for every factor in the means of each week indicate significance for P<0.05, according to Tukey's multiple comparison of means.

Ross 308 showed mean values of 235.2 g in the first week, and 2 933.6 g in the sixth week. The outcome of the first week was higher than the one reported in the manual of yields for males (Aviagen, 2017), weighing 189 g. However, in the sixth week, it was lower than the description found in the same manual (3 023 g).

Cobb 500 showed the same results as Ross 308, when compared to the weights suggested by the performance table of the line for males (Cobb-Vantres, 2015), weighing 186 and 3 044 g respectively.

The results presented in both manuals were not based on environmentally controlled conditions, different from the conditions of the experiment. It was done in open-sided systems where the climatic variables have effects on the results, which was different when the results from the first week were compared; then the temperature was controlled in the section, and the values were higher than the ones suggested in the manuals.

Also, a trial performed by Gonzales *et al.* (2013) published weights of 2 893 g at 42 days, using Cobb-Vantress 500 supplemented with organic acids and antibiotics, which were lower than the values achieved in this experiment.

In this study, the final weight found in Ross 308 was above the weight range (2 026.4 and 2 105.5 g), achieved by Valenzuela, Carvalo, Morales, and Reyes (2015), when they used dry ensiled salmon in the diet of chickens. Besides, this study produced a better weight (2 993.6 g) than the 2 026.4 achieved by the previous authors, when no salmon supplement was supplied, at finishing age.

The same lines used in this study were used to evaluate the productive performance in the Ecuadoran Amazon, with final reported values of 2 773.85 and 2 652.81 g in Cobb 500 and Ross 308, respectively, in 49 days, published by Andrade-Yucailla, Toalombo and Andrade-Yucailla (2017), thus the outcome in terms of weight were better in this study, though rearing was stopped at day 42.

Ross 308 showed better means than Cobb 500 in weeks 2, 3, 4, and 5; however, the final weight in week 6 was not significant, evidencing the possible use of both lines, with the same fattening results in 42 days.

Regarding the effect of the factors studied on weekly food consumption (Table 3), Cobb 500 was better in week 4, with a mean of 1 207.7 g, whereas Ross 308 averaged 1 279.1 g, and it was better in week 6

(2 040.9 g). In the same week, the other line consumed more than 2 228.2 g; the results were similar in all the other weeks. The utilization of pellets was better in weeks 1, 2, 3, and 4, and similar means were observed in weeks 5 and 6. The stocking density of 14 chicken/m^2 was better only than the 12 chicken/m^2 in weeks 2 and 4, but the same as 13 chicken/m^2. In all the other weeks it had an equivalent performance.

A research done by Parra (2017) showed means within the 4 879-5 017 g range, using supplementation of sodium butyrate in the diet of the two lines studied. As can be observed, the consumption means in week 6 were lower than the ones reported by the author in the treatments studied.

Table 3. Performance of weekly food consumption (WFCP) in the main factors studied throughout the six experimental weeks.

WFCP (g)	Lines (Mean)		Feeding (Mean)		Stocking density chicken/m^2 (Mean)		
	Ross 308	Cobb 500	MEAL	PELLETS	12	13	14
Week 1	438.4	423.3	453.67[a]	408.07[b]	439.4	430.1	423.1
Typical error	± 12.01		± 7.27		± 15.13		
Week 2	836.1	816.1	935.67[a]	716.6[b]	851.7	810.1	816.6
Typical error	± 52.45		± 19.01		± 66.73		
Week 3	1219.8	1141.9	1355.9[a]	1005.8[b]	1235.7	1164.5	1142.4
Typical error	± 86.53		± 40.62		± 110.10		
Week 4	1279.1[a]	1207.7[b]	1260.0[a]	1226.87[b]	1272.3[a]	1221.0[ab]	1237.0[b]
Typical error	± 13.20		± 19.29		± 23.59		
Week 5	1753.6	1624.3	1701.8	1676.2	1707.5	1659.3	1700.3
Typical error	± 22.34		± 35.91		± 45.73		
Week 6	2228.2[a]	2040.9[b]	2143.67	2125.47	2142.7	2097.5	2163.5
Typical error	± 40.62		± 57.34		± 72.84		

a, b: Unequal letters for every factor in the means of each week indicate significance for $P<0.05$, according to Tukey's multiple comparison of means.

Table 4 shows the consumption means of accumulated food, along with the typical error during the weeks studied in all the factors. Line only showed significant differences in week 6, when Cobb 500 was better, with a mean of 10 172.5 g, whereas Ross 308 showed 10 562.5 g; food presentation showed significant differences in weeks 2, 3, 4, and 6, the pellets were more suitable than the meal. In the other weeks, this factor showed no statistically significant differences. The three stocking densities showed no significant differences in any week.

Gonzales *et al* (2013) studied food consumption of Cobb 500 with supplementation of organic acids for 42 days, and reported 5 051-5 254 g at the end of production, which were lower than the ones shown in table 4 (10 172.5 g). The accumulated result was influenced by the number of animals in the experiment, the author used a total of 111 animals; however, the current research included 300 animals, as well as two types of food presentation. Anyway, the supplement must decrease consumption, since the animals meet their needs with less food.

A study by Parra (2017) of accumulated food for 42 days in Cobb 500 and Ross 308 broilers, with the additional effect of sodium butyrate in the diet, showed means of 21.072-21.240 g, the two were higher than the outcome in this research (10 562.5 g in Ross 308 and 10 172.5 g in Cobb 500).

Table 4. Effect of the main factors on accumulated food consumption (ACFC) in every week of the experiment

ACFC (g)	Lines		Feeding		Stocking density		
	Ross 308 Mean	Cobb 500 Mean	Meal Mean	Pellets Mean	12 chicken/m² Mean	13 chicken/m² Mean	14 chicken/m² Mean
Week 1	3245.5	3341.5	3317.0	3270.0	3299.0	3313.0	3267.6
Typical error	± 51.60		± 46.97		± 64.06		
Week 2	4081.6	4157.6	4252.67[a]	3986.6[b]	4150.7	4124.0	4084.2
Typical error	± 69.14		± 36.64		± 93.27		
Week 3	5301.5	5299.5	5608.6[a]	4992.4[b]	5386.4	5288.5	5226.6
Typical error	± 142.5		± 45.18		± 183.08		
Week 4	6580.6	6507.3	6868.6[a]	6219.27[b]	6658.7	6509.5	6463.6
Typical error	± 151.65		± 55.28		± 194.39		
Week 5	8334.3[a]	8131.6[b]	8570.4	7895.4	8366.2	8168.8	8163.8
Typical error	± 160.82		± 74.43		± 210.26		
Week 6	10562.5[a]	10172.5[b]	10714.1[a]	10020.9[b]	10508.9	10266.3	10327.4
Typical error	± 174.63		± 118.26		± 244.80		

a, b: Unequal letters for every factor in the means of each week indicate significance for $P<0.05$, according to Tukey's multiple comparison of means.

Table 5 shows the behavior of food conversion according to the factors studied. Feeding was the one with the highest significant differences in weeks 1, 2, 3, 4, and 5 (always best for pellets). The lines only differed significantly in weeks 5 and 6, Cobb 500 showed the lowest means, and therefore, a better performance for that indicator. The stocking densities showed significant differences in week 5, different from the 12 chicken/m² and 14 chicken/m², as the stocking density mean of 13 chcken/m² was the same as the other two.

In relation to food conversion, Gonzáles *et al* (2013) reported values within 1.734-1.825, inferior to the ones achieved in this research in any of the weeks and factors studied, and also, in relation to the mean of 6 weeks in the two lines. The mean in Cobb 500 was 1.97 kg food/kg live weight, and in Ross 308, with 1.91 kg food/kg live weight.

A comparison of the results in table 5 with the yield manuals showed that in the males of both lines, the means are slightly higher than the ones suggested, mainly due to the lack of correspondence of the chicken environment in the houses to the recommendations in the manuals, based on controlled environments, as opposed to the open environments used in the current research.

Table 5. Evaluation of food conversion (FC) in the experimental weeks in relation to the main factors studied

FC (g)	Lines (Mean)		Feeding (Mean)		Stocking density (Mean)		
	Ross 308	Cobb 500	Meal	Pellets	12 chick-en/m²	13 chick-en/m²	14 chick-en/m²
Week 1	0.84	0.82	0.84	0.81	0.82	0.82	0.84
Typical error	± 0.01		± 0.02		± 0.021		
Week 2	1.17	1.19	1.16	1.19	1.14	1.20	1.20
Typical error	± 0.05		± 0.05		± 0.068		
Week 3	1.43[a]	1.44[b]	1.45[a]	1.41[b]	1.43	1.42	1.45
Typical error	± 0.10		± 0.10		± 0.125		
Week 4	1.67	1.72	1.72	1.67	1.69	1.70	1.70
Typical error	± 0.11		± 0.11		± 0.146		
Week 5	1.69	1.75	1.73	1.70	1.73	1.70	1.72
Typical error	± 0.09		± 0.09		± 0.117		
Week 6	1.91	1.97	1.97	1.94	1.92	1.93	1.97
Typical error	± 0.08		± 0.08		± 0.098		

a, b: unequal letters for every factor in the means of each week indicate significance for $P<0.05$, according to Tukey's multiple comparison of means.

CONCLUSIONS

The two lines showed a similar productive performance at 42 days. The final weights achieved were adequate, and food conversion was efficient.

The inclusion of three stocking densities demonstrated the suitability of broiler chickens (Cobb 500 and Ross 308) in a shed under tropical conditions.

Food presentation showed no significant differences, so the meal can be used to reduce production costs.

REFERENCES

Alvarado, H.; Guerra, l.; Vázquez, R.; Ceró, A.; Gómez, J. y Gallón, E. (2018), in this journal. Comportamiento de indicadores productivos en dos lineas de hembras Broilers con dos sistemas de alimentación en condiciones ambientales del trópico. *Revista de Producción Animal, 31*(3), en edición.

Andrade-Yucailla, V.; Toalombo, P.; Andrade-Yucailla, S. y Lima-Orozco, R. (2017). Evaluación de parámetros productivos de pollos Broilers Coob 500 y Ross 308 en la Amazonia de Ecuador. *Revista electrónica de Veterinaria, 18*(2), 1-8. doi:http://www.veterinaria.org/revistas/redvet/n020217.html

Aviagen (2017). *Ross308AP-Broiler-PO-2017-ES.* Retrieved on June 29, 2019, from: http://es.staging.aviagen.com/assets/Tech_Center/BB_Foreign_Language_Docs/Spanish_TechDocs/Ross308AP-Broiler-PO-2017-ES.pdf

Bueno, D.; López, N., Rodríguez, L. y Procura, F. (2016). Producción de pollos parrilleros en países sudamericanos y planes sanitarios nacionales para el control de Salmonella en dichos animales. *Rev. Agron. Noroeste Argent, 36*(2), 11-12.

Coob Vanter, 5. (2015). *Suplemento informativo sobre rendimiento y nutrición de pollos de engorde.* Manual. Retrieved on March 28, 2019, from: http://www.cobb-vantress.com/docs/default-source/cobb-500-guides/cobb500_bpn_supp_

Gonzáles, S.; Icochea, E.; Reyna, P.; Guzman, J.; Cazorla, F.; Lúcar, J. *et al.* (2013). Efecto de la suplementación de ácidos orgánicos sobre los parámetros productivos en pollos de engorde. *Revista Investigaciones Veterinarias de Perú, 24*(1), 32-37.

Parra, Y. (2017). *Alimento Balanceado Para Pollos. Aliméntalos Así y Explota Su Potencial Productivo*. Retrieved on June 29, 2019, from: https://inta.gob.ar/documentos/produccion-de-pollos-parrilleros-en-paises-sudamericanos-y-planes-sanitarios-nacionales-para-el-control-de-salmonella-en-dichos-animales.

Valenzuela, C.; Carvalo, F.; Morales, M. y Reyes, P. (2015). Efecto del uso de ensilado fresco de salmón en dietas de pollos broilers sobre parámetros productivos y calidad sensofrial de la carne. *Archivo médico veterinario, 47*(1), 53-59.

.

Received: 1-15-2019
Accepted: 6-3-2019

AUTHOR CONTRIBUTION

Author participation included research conception and design: HJAA, LDGC, RVM. Analysis and data interpretation: RVM, LDGC, HJAA, JLSP. Redaction of the manuscript: HJAA, LDGC, AECR, JLSP.

CONFLICT OF INTERESTS

None