Rev. Bras. Saúde Prod. Anim., Salvador, v.23, 01 - 11, e20220017, 2022
http://dx.doi.org/10.1590/S1519-9940202200172022

Animal Production and Environment
Received on: 06/06/2022
Accepted on: 27/08/2022

Parâmetros produtivos em três modelos de produção: *piso, gaiola e pastejo em aves posturais* em Ocaña Norte de Santander

Productive parameters in three production models: floor, cage and grazing in layer poultry in Ocaña Norte de Santander

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ABSTRACT

The objective was to evaluate the three housing systems in laying birds to determine animal welfare and productivity parameters of the Isa Brown line. 135 laying hens distributed in 45 hens were used for each exploitation system; the managed feeding was 114gr/bird/day in the floor and cage systems for the entire trial period, for the grazing system 14 gr less of concentrate were used; the study had a duration of 8 weeks, of which the first was for accustoming and 7 for testing; At the end of each week, 9 eggs were collected to be studied and analyzed in the animal nutrition laboratory, using 3 eggs for each housing system. The information obtained was analyzed using SPSS for each variable. The parameters of production, consumption, feed conversion, and egg weight, were evaluated; where one-factor ANOVA and Tukey HSD test and least significant difference. The percentage production was no significant difference between the three cage floor and grazing production models being (P-Value <0.05), for the food consumption parameter there is a significant difference (P-Value> 0.05) for each housing system (34.54 ± 6.93), also happened with the conversion variable between the floor, cage production models with the grazing one (1.93 ± 0.6), for the egg weight they were similar in all housing systems (61.1 g in cage, 60.8 g in floor and 60.6 g in grazing) where there were no significant differences. In conclusion, birds with a lower housing density allow better behavior, which is an indicator of comfort, generating higher productivity.
Keywords: eggs, feed, hens, production, systems

RESUMO

O objectivo era avaliar os três sistemas de habitação (solo, gaiola e pasto) nas galinhas poedeiras para determinar os parâmetros de bem-estar animal e produtividade da linha Isa

ISSN 1519 9940

RBSPA
Revista Brasileira de Saúde e Produção Animal

Rev. Bras. Saúde Prod. Anim., Salvador, v.23, 01 - 11, e20220017, 2022
http://dx.doi.org/10.1590/S1519-9940202200172022

Brown. Foram utilizadas 135 galinhas poedeiras, distribuídas em 45 galinhas por sistema; a ração administrada foi de 114 g/ave/dia no chão e sistemas de gaiolas, e 14 g menos concentrado foi utilizado para o sistema de pastagem; o estudo durou 8 semanas; a primeira semana foi para habituação e 7 semanas para testes. Foram recolhidos três ovos por sistema por semana para serem estudados e analisados no laboratório de nutrição animal. Os dados foram analisados com SPSS para cada variável. Os parâmetros de produção, consumo, conversão alimentar e peso dos ovos foram avaliados utilizando um único factor ANOVA e o teste HSD de Tukey para a diferença menos significativa. A percentagem de produção não tinha diferença significativa entre os três modelos de produção (valor $P < 0,05$), para o parâmetro de consumo de ração havia uma diferença significativa (valor $P > 0,05$) para cada sistema de habitação (34,54 ± 6,93), a variável de conversão alimentar entre modelos de produção (1,93 ± 0,6), para os pesos dos ovos eram semelhantes em todos os sistemas de habitação (61,1 g para a gaiola, 60,8 g para o solo e 60,6 g para o pasto) onde não havia diferença significativa. Em conclusão, as aves com menor densidade de alojamento permitem um melhor comportamento, o que é um indicador de conforto, levando a uma maior produtividade.
Palavras-chave: Alimentação, Galinhas, Ovos, Produção, Sistemas

INTRODUCTION

The predominant systems for egg production are the cage and floor systems, each of which has a different impact on the well-being of the hens (Holt et al., 2011). On the other hand, birds on the ground are free to move within the space and develop almost all their natural behaviors, but the productive and economic parameters are not as efficient as in the other systems, which results in higher production and waste costs. of resources, which affects the final price of the egg (Donaldson & O‟Connell., 2012).
One of the production alternatives is the free grazing system, which is booming both due to the growing demand for field eggs, as well as the interest of society in the welfare of the birds (España et al., 2019).
In Colombia, poultry farms have been in full growth; this increase in the population of birds and especially egg production has caused the farms to be more technified and seek greater profitability in a small space; In this search for dividends, animal health and welfare have been put aside (Aguilera., 2014).
The search for new, more sustainable poultry production systems is a viable option in third world countries. Also, the request for healthier products and systems more adaptable to the environment makes the national and international markets grow. This shows us that sustainable animal production has the potential to expand and develop, in contrast to conventional animal production systems (Fao., 2003).
The genetic improvements carried out in the poultry industry (broilers, laying hens and turkeys) result in very efficient commercial birds, with which it has been possible to obtain higher productivity in less time and space, however, satisfying the Increasing demand for cheap food for human consumption has resulted in neglecting the comfort that these animals require and their natural ethology has been altered (Dottavio & Di Masso., 2010)
Laying birds over time have been managed in systems such as floors, cages

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and grazing. The purpose of this research is to show which of these systems is the most convenient and favorable for the birds; at the same time, we want to identify which of these systems generates better levels of economic production, based on the parameters obtained throughout the investigation.

MATERIALS AND METHODS

The data of the study come from 135 laying hens distributed in 45 hens for each exploitation system (*Floor, Cage, and Pasture*); the managed feeding was 114 gr / bird / day in the floor and cage systems for the entire trial period, for the grazing system 14 gr less of concentrate were used; To meet the different nutritional needs, the grass was used for yatago (*Trichanthera gigantea*), the legumes forage peanut (*Arachis pintoi*) and slaughterhouse (*Gliricidia sepium*) and the forage button of gold (*Tithonia diversifolia*); The study had a duration of 8 weeks, of which the first was for accustoming and 7 for testing (week 35 to 41 of production); At the end of each week, 9 eggs were collected to be studied and analyzed in the animal nutrition laboratory, using 3 eggs for each housing system, the genetic line used was the Isa Brown of the poultry project of the Universidad Francisco de Paula Santander, Ocaña.

The place of study was in the poultry project of the experimental farm of the Francisco de Paula Santander Ocaña University (UFPSO), located three kilometers from the urban center of the city. The place chosen for the study has the following characteristics: height above sea level of 1150 meters, average annual rainfall of 1000 to 2000 millimeters, the relative humidity of 70%, and average daily temperature of 23 ° C, it is located on the river bank Algodonal, within the university campus; the coordinates are: longitude 73 ° 19´ 189” W, Latitude 8 ° 14´ 257” N (Corponor, 2010).

The statistical model used for this research is completely random, the statistical analysis of the data was carried out in the SPSS package (VERSION 23). Performing analysis of variance of a factor; the treatments were each of the housing systems (floor, cages, and grazing), and the replications were the 7 weeks of trial.

For the results obtained, formulas for egg production, feed consumption, feed conversion, and egg weight were used.

RESULTS

The different productive parameters of production, consumption, feed conversion, and egg weight were evaluated (Table 1); where one-factor analysis of variance (ANOVA) and Tukey HSD test (Tukey's honestly significant difference) and minimum significant difference (DMS) were performed for the respective significant differences; the results were averaged over the seven weeks of the investigation (IBM SPSS Statistic, 2017).

Table 1. Poultry production parameters

Evaluation parameter	Operating system		
	Floor	**Cage**	**Grazing**
% P.D.N	94,69 ± 2,06	94,74 ± 2,24	92,92 ± 1,70
C	114 ± 0,00	114 ± 0,00	98,57 ± 3,8
C.A	1,99 ± 0,10	2,01 ± 0,12	1,78 ± 0,15
P.H	60,58 ± 2,34	61,08 ± 3,10	60,8 ± 2,83

Mean values ± standard deviation of the variables for the productive parameters, % P.D.N: Percentage of production, C: Consumption, C.A: Food conversion, P.H: Egg weight

The analysis of variance of one-factor ANOVA (Table 2), decomposed the variance of the data into two components: a component between groups and a component within groups, this reflected that there is no significant difference between the groups about the percent production, with a calculated F of 0.70 versus a critical 3.55 F; the egg weight obtained a calculated F of 0.06 is less than the critical F 3.55. For the percentage of production (Figure 1), an increase in the data observed from week 37 was reported, for each of the production systems; regarding the weight of the egg (Figure 2), it was observed that in the first 5 weeks of the test, the weight was below that suggested by the genetic line.

Table 2. Analysis of variance of an ANOVA factor for the poultry production parameters

Evaluation Parameter	F. Calculated	Sum Of Squares (Between The Groups)	Sum Of Squares (Within The Groups)
% P.D.N	0,70*	2,76	35,75
C	116,64*	1110,86	85,71
C.A	7,81*	0,25	0,28
P.H	0,06*	0,90	138,68

* It was compared with Critical F 3.55 for each of the production parameters,% P.D.N: Percentage of production, C: Consumption, C.A: Feed conversion, P.H: Egg weight, * Significant statistical difference.

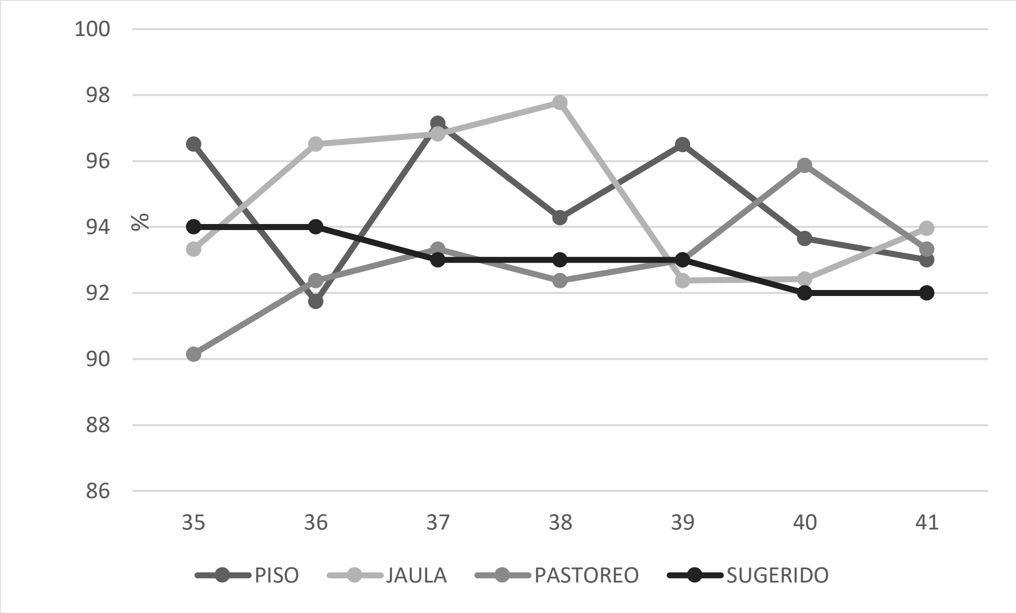

Figure 1. Egg production

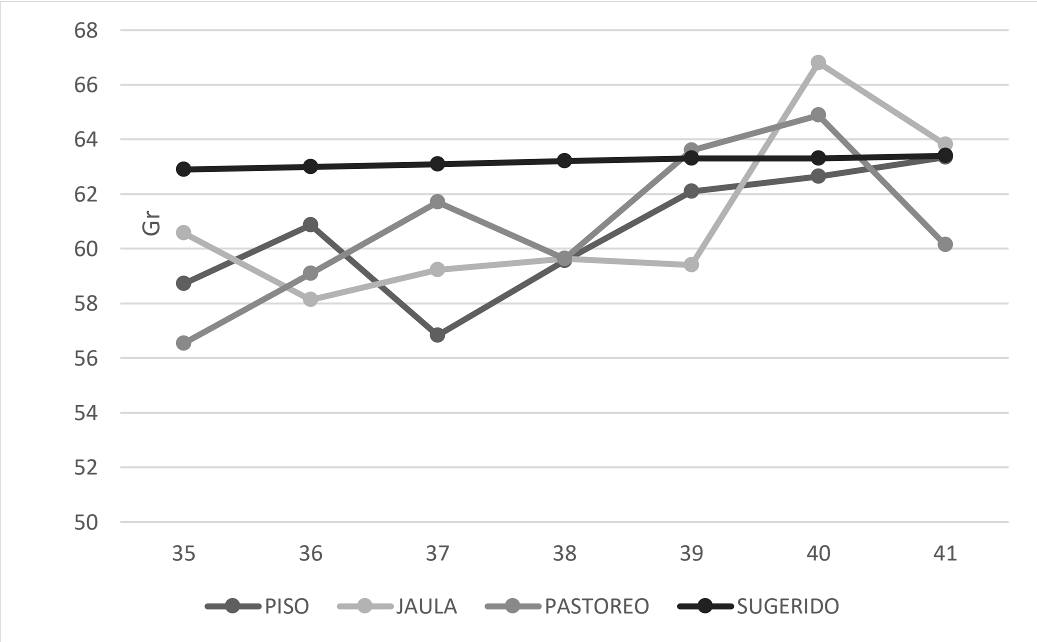

Figure 2. Egg weight

The ratio F for food consumption is a ratio of the estimate between groups to the estimate within the groups. It reflects that there is a significant difference between the groups, the value for the calculated F being 28.46 higher than the critical F value, which is 3.55, which indicated a significant difference for this parameter (Table 2).

Regarding feed conversion, 7.81 was obtained for calculated F, against 3.55 for critical F, where a significant statistical difference was evidenced (Table 2).

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In the analysis of the multiple range methods HSD and DMS (Table 3 and Table 4), the statistically significant difference is evidenced, based on the fact that the grazing housing system was supplied 14 g less of concentrate than the floor and cage system; The grazing system was the one that obtained the lowest consumption, due to the supply of forage at will, the amount of supply for each housing system was 100 gr for the grazing system and 114 gr for the floor and cage housing system (Figure 3 and Figure 4).

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Table 3. Method: 95.0 percent Tukey HSD (Tukey Honestly Significant Difference) and Minimum Significant Difference (DMS) for feed consumption

Multiple comparisons

Dependent variable: response

	(I) trata	(J) trata	Difference of means (I-J)	Standard error	Sig.	95% confidence interval	
						Lower limit	Upper limit
HSD Tukey	1	2	,00000	,63356	1,000	-1,6170	1,6170
		3	4,14000*	,63356	,000	2,5230	5,7570
	2	1	,00000	,63356	1,000	-1,6170	1,6170
		3	4,14000*	,63356	,000	2,5230	5,7570
	3	1	-4,14000*	,63356	,000	-5,7570	-2,5230
		2	-4,14000*	,63356	,000	-5,7570	-2,5230
DMS	1	2	,00000	,63356	1,000	-1,3311	1,3311
		3	4,14000*	,63356	,000	2,8089	5,4711
	2	1	,00000	,63356	1,000	-1,3311	1,3311
		3	4,14000*	,63356	,000	2,8089	5,4711
	3	1	-4,14000*	,63356	,000	-5,4711	-2,8089
		2	-4,14000*	,63356	,000	-5,4711	-2,8089

*. The difference in means is significant at the 0.05 level.

Tukey and DMS analysis to evaluate the significant differences with each of the accommodation systems, shows the differences between each of the accommodation systems. 1: Floor, 2: Cage, 3: Grazing.

Table 4. Method: 95.0 percent Tukey HSD (Tukey's honestly significant difference) and least significant difference (DMS) for feed conversion

Multiple comparisons

Dependent variable: response

	(I) trata	(J) trata	Difference of means (I-J)	Standard error	Sig.	95% confidence interval	
						Lower limit	Upper limit
HSD Tukey	1	2	-,02000	,06697	,952	-,1909	,1509
		3	,21857*	,06697	,011	,0477	,3895
	2	1	,02000	,06697	,952	-,1509	,1909
		3	,23857*	,06697	,006	,0677	,4095
	3	1	-,21857*	,06697	,011	-,3895	-,0477
		2	-,23857*	,06697	,006	-,4095	-,0677
DMS	1	2	-,02000	,06697	,769	-,1607	,1207
		3	,21857*	,06697	,004	,0779	,3593
	2	1	,02000	,06697	,769	-,1207	,1607
		3	,23857*	,06697	,002	,0979	,3793
	3	1	-,21857*	,06697	,004	-,3593	-,0779

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http://dx.doi.org/10.1590/S1519-9940202200172022

	2	-,23857*	,06697	,002	-,3793	-,0979

*. The difference in means is significant at the 0.05 level.

Tukey and DMS analysis to evaluate the significant differences with each of the housing systems, the differences between each of the housing systems are shown, 1: Floor feed conversion, 2: Cage feed conversion, 3: Feed conversion of grazing.

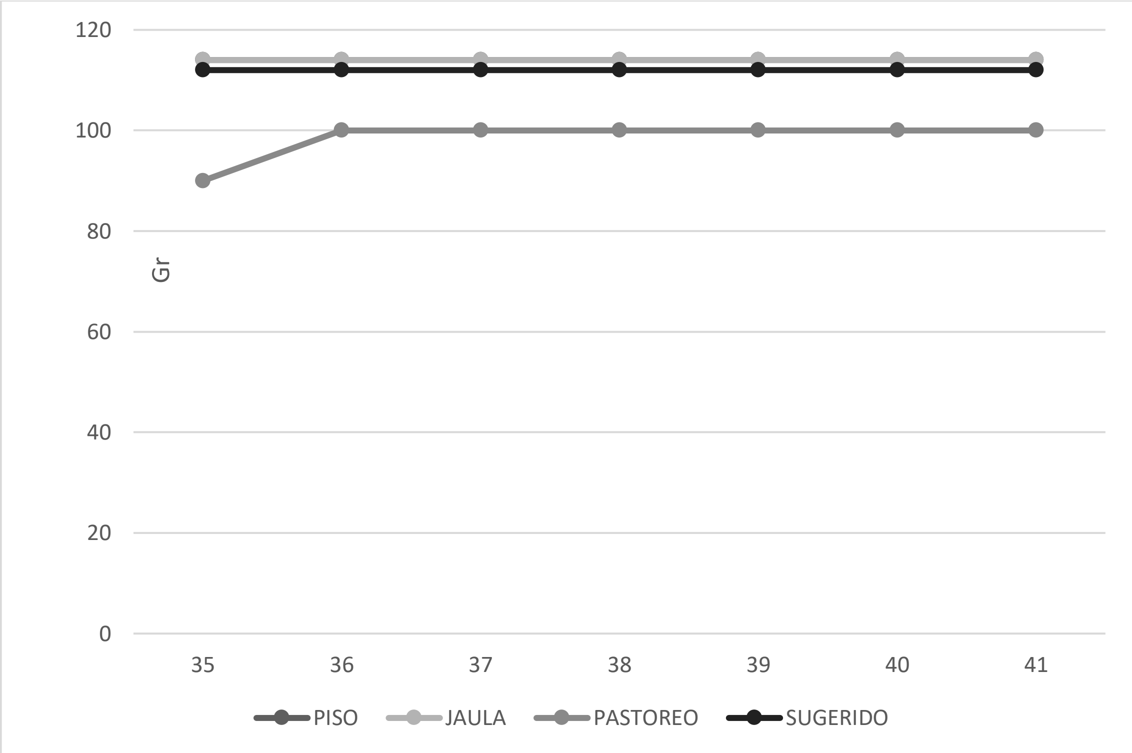

Figure 3. Food consumption

ISSN 1519 9940

Rev. Bras. Saúde Prod. Anim., Salvador, v.23, 01 - 11, e202200172022, 2022
http://dx.doi.org/10.1590/S1519-9940202200172022

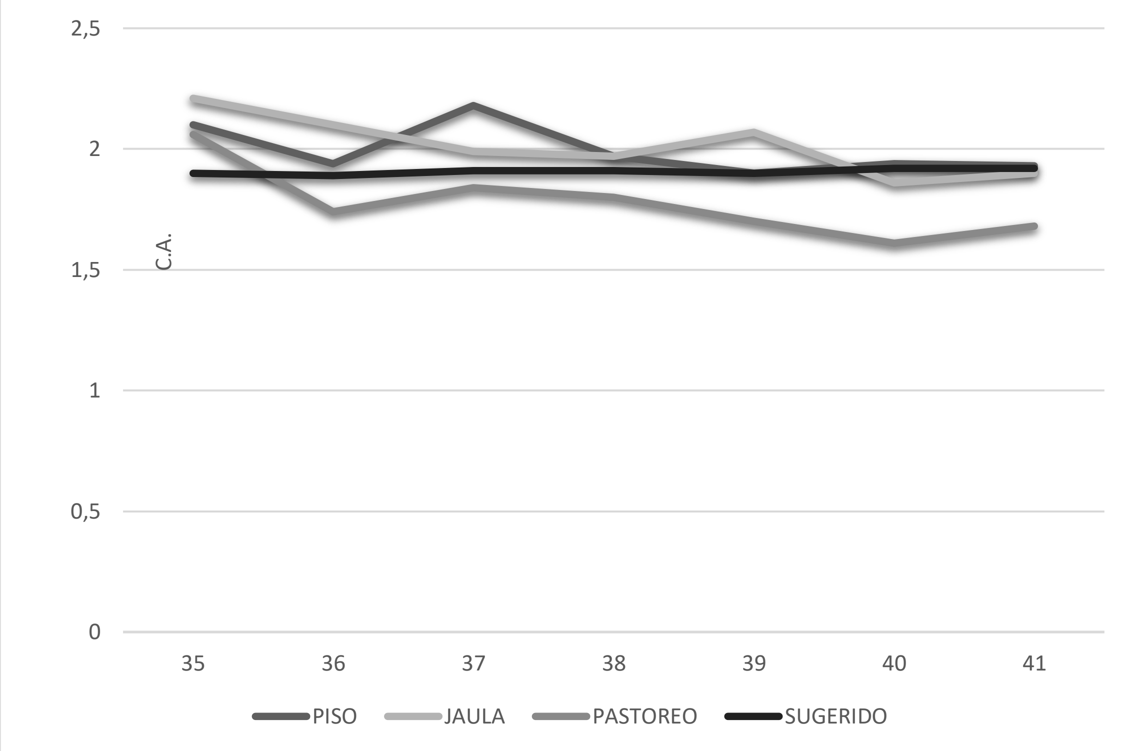

Figure 4. Feed conversion

DISCUSSION

Within the statistical analysis developed during the seven weeks of testing, it was found that there is no statistically significant difference in the percentage of production (0.70 ± 3.55), and in the weight of the egg (0.06 ± 3.55), where P-Value > 0.05 was obtained; but if significant differences were found for the consumption parameters (28.46 ± 3.55) and food conversion (7.81 ± 3.55), with P-Value <0.05.

In the variable% of production, the statistical analysis of the seven weeks of the trial showed that there is no significant difference between the three models of cage-floor and grazing production, with P-Value> 0.05; the floor system is the one with the highest percentage of production obtained (94%) followed by the cage systems (93%) and grazing (92%) being higher (2%) for the floor system, (1%) for the cage system and similar in grazing compared to the average (92%) of the Isa Brown line of birds (line worked in this research), in the same way in the study carried out by (Julca, 2018) it was evidenced that no there is a statistically significant difference for this parameter, taking into account that the study carried out was from week 60 to 70.

In the case of egg weight, they were very similar in all housing systems (61.1 g for the cage, 60.8 g for the floor, and 60.6 g for grazing) and performing the analysis of variance of a factor, it is evidenced that there is no significant difference P-Value> 0.05; in contrast to the results found by Castañeda & Gómez (2010), working with birds of the Hy Line Brown line “In general terms, there was

ISSN 1519 9940

http://dx.doi.org/10.1590/S1519-9940202200172022

a trend towards higher production of grazing birds".

Regarding the food consumption variable, the statistical analysis of ANOVA showed that there is a significant difference (P-Value <0.05) between each of the production models (116.64 ± 3.55), where the average consumption for the floor and cage system was 114 gr / bird / day and 14 gr less for the grazing system. These results are higher than those obtained by Castañeda & Gómez (2010), who obtained in the floor system of 113.44 gr, cage 113.44 grams grazing 103.47 grams, because this test was carried out from 23 weeks old.

Within the assessment made for the conversion variable, between the floor, cage, and grazing production models, it was evidenced that there are significant differences (7.81 ± 3.55), where an average record was obtained for the grazing system 1.78, followed by the 1.99 -floor system, and finally the 2.01 cage system; coinciding with that reported by Castañeda & Gómez (2010), where they obtained statistical differences for each of the production systems, with average data of 1.59 for the floor system, 1.62 cages, and 1.39 grazing; showing that in the grazing system the food is better used to produce a daily egg.

CONCLUSION

In this study it is concluded that birds with a lower housing density allow better behavior, which is an indicator of comfort (such as stretching the legs, playing, resting, among others), generating greater productivity; When the bird is in situations of environmental stress, they show a reduction in production, understanding how productive levels can be good indicators of the adaptation and well-being of the birds.

The hens transferred to the cage rearing system do not allow well-being conditions as satisfactory as the other two systems, due to the limited space; In this system, small physical changes were noted in the birds: the plumage color was stronger, redder ridges, fewer degrees of egg dirt, greater nail length, and body condition. It was evidenced that the percentage of laying and egg weight is stable and manage to be maintained once the hens are adapted.

The animal welfare of birds is influenced by certain factors such as population density, the environment, type and quality of food, management, among others; the composition of the egg varies with the age of the hen and the type of handling, the most important factor, however, is the feeding.

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ISSN 1519 9940