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Full Length Research Paper

Productive performance of *Rhode Island Red* hens fed with foliage shrubs

Santos Magdalena Herrera Gallo[1]*, Aslam Díaz Castillo[2], Geovanny Muñoz Rodríguez[1], Italo Espinoza Guerra[1], José Miguel Romero Romero[1] and Tito Solís Barros[1]

1 Universidad Técnica de Quevedo (UTEQ), Facultad de Ciencias Pecuarias, Carretera de Quevedo Santo Domingo de los Tsáchilas, km 1 ½, Quevedo, Los Ríos, Ecuador.
2 Universidad de Guayaquil. , Facultad de Medicina Veterinaria, Avenida Kennedy y Delta, Guayaquil, Guayas, Ecuador.

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The objective of this study was to evaluate the productive performance of Rhode Island Red hens fed with foliage shrubs (*Gliricidia sepium*, *Cajanus cajan* and *Morus alba*), as replacement of corn and soybean in diet. A total of 100 hens (22-33 weeks old) were distributed in a randomized block design with a control group (based on corn and soybeans) and three experimental groups (5% of shrub in diet), 25 animals/group, five replicates/treatment, five animals/replicate were used. Initial and final weight; consumption; production and quality of eggs were measured. The highest final body weight was obtained in hens that consumed *M. alba* (2194.33 g/animal). The greatest consumption was obtained in the control (8644.18 g) and *M. alba* (9509.96 g) diet. There were no differences in consumption (796.37-807.64 g/animal/week) and feed conversion (2.10-3.04). The biggest egg production was obtained with control group and *M. alba* (6.09 and 5.32 eggs/week/hen, respectively). The egg average weight /week were similar in control, *M. alba* and *C. cajan* (61.19-63.47 g). There were no differences in the eggs size (56-60 g); form and egg yolk pigmentation (between yellow and strong yellow color). The worst results were obtained with *G. sepium*. It can be suggested the replacement of 5% of corn and soybean in the diet of *Rhode Island Red* hens with leaf from *M. alba* and obtain favorable productive performance of hens.

Keywords: behavior, egg laying, feed intake.

INTRODUCTION

Flours from foliages from shrubs such as *Morus alba*, *Gliricidia sepium* and *Cajanus cajan* have been used as options for reducing the cost of feed in raising of laying hens and broilers (Chakoma *et al*. 2004; Sánchez, 2009; Casamachin *et al*. 2007; Herrera, 2014). The three plants are cultivated in tropical regions for its high content of protein, energy and minerals. *C. cajan* and *G. sepium* belong to the *Fabaceae* family and *M. alba* is of *Moraceae*

*Corresponding Author's Email: mallyhe55@hotmail.com

family. (Cuervo *et al.* 2013; Herrera, 2014; Rufini, 2014). Flours leaves these three shrubs could be used for the replacement of part of the corn and soybean diet hens *Rhode Island Red* in laying phase. These birds have greater hardiness than commercial laying hens (Pampin, 2010; Sarmiento, 2012; Herrera *et al.* 2015). However, it is necessary to study the variation of body weight; consumption; and production and quality of eggs with the inclusion in the diets of shrubs, as a novel alternative, because of its effect is not known.

The objective of this study was to evaluate the productive performance of *Rhode Island Red* hens fed meal from shrub (*G. sepium*, *C. cajan* and *M. alba*), as replacement of corn and soybean in diet.

MATERIALS AND METHODS

The research was conducted in province Los Ríos, Ecuador, a 01° 06' south latitude and 79° 29' west longitude, 75 meters above sea level, with an annual average temperature of 24.70 °C, relative humidity 87%, average annual rainfall of 2613 mm, annual heliophany of 886 h and clay loam soil.

M. alba (var. Criolla) and *G. sepium* were planted with cuttings (inclined) of 40 cm, a distance between plants of 40 cm and 1 m between rows, in an area of 5000 m2 which was divided into three batches (1667 m^2/batch) according to the age of the seed (30; 45 or 60 days after re-emergence) and fertilized with organic fertilizer (300 kg/ha/year). *C. cajan* was sown with 18 kg of seed/ha broadcast, because its objective was as forage. The initial cut was made after one year of establishment. The foliage (leaves and tender stems) were collected manually, dried in the shade, on a cement floor for three days, homogenized, ground and stored for later use in rations, with successive cuts every 45 days. The dry matter (88%); crude protein (17.13%); metabolizable energy (11.55 MJ/kg); ethereal extract (4.03%); crude fiber (4.90%); calcium (3.56%) and phosphorus (0.45%) were determined (AOAC, 2012).

Rhode Island Red hens in oviposition phase (22-33 weeks old) were used. The birds were vaccinated against Infectious Coryza at 28 weeks of age. The animals were housed in rustic facilities and raised in floor with a bed of 15 cm. The area was divided with fences, to assign the animals to different groups (1 m^2 for replica). The animals were adapted to diets for seven days. The Birds received the ration once daily. The three experimental groups were fed with flour foliage shrub (treatments I, II and III), at the level of 5% of inclusion. The control group consumed a diet of corn and soybeans, fundamentally. The diet were formulated according to the requirements for these phases (Santiago *et al.* 2011), with the following composition: corn flour, 54.47-56.57%; fish flour, 2.50%; rice dust, 2-6; soy flour, 21-23%; palm oil, 0.50-1.40%; sodium chloride, 0.50-0.52%; calcium carbonate, 8.50-9; di-calcium phosphate, 1.50-1.60%; Methionine, 0.10-0.12%; premix of vitamins and minerals, 0.15%; phytase, 0.01%; propionic acid, 0.05; antirust, 0.05%; and formalin, 0.05%. The animals had free access to water and food.

The animals were weighed at the beginning and end of the experiment, at 7:30 am. Voluntary intake was measured once a week (method of supply-rejection of foods). The feed conversion was calculated (food consumed in seven days on average, between eggs produced on average each week, multiplied by the average weight of the eggs). Egg size was evaluated with the following scale: 1, small (50-55 g); 2, medium (56-60 g); and 3, large (61-65 g). The eggs shape were determined as follows: normal (egg-shaped) and deformed eggs. The number and weight of eggs were evaluated each week. The egg yolk pigmentation was evaluated visually, with the colorimetric scale Roche. The egg yolk colour score were: 1, pale-yellow; 2 strong-yellow; and 3 yellow-orange. The animals were distributed in a randomized block design, with a control group and three experimental groups (25 animals/group), five replicates/ group, five animals/replicate.

Data were analyzed by SAS software (Statistical Analysis System), version 9.3 (2013) to evaluate descriptive statistics (mean and standard deviation) and multiple range test Turkey were used to compare means, in the analysis of variance (ANOVA), to 0.05 of significance level.

RESULTS AND DISCUSSION

There were no differences ($P < 0.05$) in the initial body weight (table 1). Although, the highest final weight was obtained in animals that consumed *M. alba* (2194.33 g/animal) and lowest average body weight was obtained with *G. sepium* (1740.33 g/animal). There were no differences in feed intake (796.37-807.64 g/animal/week) and feed conversion (2.10-3.04). The highest egg production was obtained in control group (table 1) and *M. alba* group (6.09 and 5.32 eggs/week /hen, respectively). The average weight egg/week was similar (61.19-63.47 g) in control, *M. alba* and *C. cajan* groups. The egg production biggest for week occurred in the control group (71.62%) and the lowest, with *G. sepium* (50.99%). There were no differences in the eggs mass (rating of 2; with 56-60 g/egg); in the eggs form (normal form, rating 1) and egg

Table 1. Live weight, feed intake, conversion, production and quality of eggs from *Rhode Island Red* hens fed meals shrubs (5% inclusion).

Indicators		Control	*G. sepium*	*C. cajan*	*M. alba*	SE (±)	Significance
Live weight average, g/animal	Initial	1437.67	1413.33	1427.67	1433.62	11.95	0.0756
	Final	1826^{bc}	1740.33^{c}	1816^{bc}	2194.33^{a}	10.78	0.0453
Feed intake average, g/animal/week		807.64	796.37	802.16	798.06	6.01	0.0942
Feed conversion		2.10	3.04	2.89	2.45	0.01	0.0624
Production, eggs/week/hen		6.09^{a}	4.51^{ab}	4.53^{ab}	5.32^{ab}	0.06	0.0431
Average weight egg/week, g		63.47^{a}	58^{bc}	61.19^{ab}	61.29^{ab}	0.23	0.0312
Production/week, %		71.62^{a}	50.99^{c}	64.18^{b}	64.38^{b}	0.89	0.0445
Egg mass index		2.75	2.08	2.50	2.66	0.03	0.0634
Egg form index		1.33	1.15	1.21	1.28	0.01	0.0679
Yolk pigmentation index		1.33	1.55	1.61	1.69	0.01	0.0742

^{a}, ^{b} and ^{c} equal Letters in the super-indices are not significantly different at $p<0.05$, multiple range test of Turkey.

yolk pigmentation, with pale-yellow and strong-yellow (1 and 2 scale).

The higher final body weight was obtained with *M. alba* and the lowest was obtained with *G. sepium* (table 1). This diferences could be due to the chemical composition of these plants. *M. alba* has less fiber and anti-nutritional elements, as opposed to presence of antinutritional factors and fiber of *G. sepium* and *C. cajan* (Savón, 2010). The composition of the *M. alba* fiber could have increased utilization efficiency of the nutrients in the diet (Gonzalvo *et al.* 2001). As for the biological value of the protein and amino acid composition, *M. alba* has higher content of essential amino acids that *C. cajan* and *G. sepium* (Leyva *et al*., 2012; Miquilena and Higuera, 2012 ; Cuervo *et al*., 2013). In the leaves of *G. sepium* have been isolated an high in tannins, saponins, coumarins, cyanogenic glycosides, nitrates, protease inhibitor, fitohemoglutininas and phytic acid (Romero *et al*., 2010; Albert and Rodríguez, 2014). *C. cajan* has high concentrations of amines, phenols, tannins, alkaloids and middle ranges of triterpenes and steroids that affecting the digestibility and voluntary feed intake. (Paixão *et al.* 2014). Saponins in *M. alba* were detected and were found polyphenols, coumarins and tannins, but in a lesser quantity. Alkaloids, polyphenols, coumarins and tripterpenos produce a bitter flavor and they reduce the palatability of forages (Albert and Rodríguez, 2014; Savón 2010). *M. alba* has low diversity of secondary structures which are indicative of reduced palatability (Savón 2010; Herrera, 2014).

Ogungbesan *et al*. (2014) used 5% of G. sepium in replacement of soyabean in diet of *Rhode Island Red hens*. They obtained performed better than those in this research, with 117 g/día of feed intake; 54.33 g of egg weigth; 2.17 kg feed/kg egg and 1515 g/animal of final live weight. With *Rhode Island Red* hens that were fed with 5% *Leucaena leucocephala* in diet, Sarmiento (2012) obtained 57.10% of rate laying egg ; 58.78 g of egg weight; 103.04 g/day of feed intake; 33.44 g/hen/day of egg mass and feed conversion of 3.51. Unlike our research, these results were obtained with hens bred in backyard.

The nutritive value of *M. alba* could justify the the best productive performance of the hens that were fed with this foliage, with respect to the hens fed *G. sepium* and *C. cajan*. In all cases, with the superiority of productive results of diets with *M. alba*, could ensure that this shrub has the nutritional potential necessary, for replace a part of corn and soybeans of the feeding of hens. There were no differences in consumption and feed conversion, because all diet has similar nutritive value. Favorable indicators of production and quality of eggs (table 1) may also be related with the animal genotype. The rusticity of *Rhode Island Red* hens enable them to make a good use of vegetable fiber for compliment your diet and ensure a more natural breeding. In this regard, Abou-elezz *et al*. (2012) and Abou-elezz *et al*. (2014) conducted ethological studies and quality of eggs *Rhode Island Red* hens grazing, from 8:00 AM to 17:00 PM. They found these hens made good use of the natural vegetation, to express a productive performance favorable: 86.90% of egg laying rate; 50.66 g for egg mass; 103.70 g/day of feed intake; production of egg yolks with more intense yellow and higher albumen proportions.

CONCLUSIONS

Can be replaced the 5% of corn and soybeans in the diet of Rhode Island Red hens , by the inclusion of leaf meal M. alba and get a favorable production performance; body weight of 2194.33 g/animal; feed conversion of 2.45; 5.32 eggs/week/hen, with no difference in feed intake and egg quality , in comparison with the commercial feed.

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