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Banana leaf in the diet of laying hens in cage free system

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ABSTRACT. The aim of this research was evaluate the productive performance, egg quality and the endoparasites presence on Carijó laying hens in Cage Free system, fed with two experimental diets, one of them supplemented with fresh banana leaf *in natura*. It were used 196 laying hens with twenty-four weeks of age, distributed in a completely randomized design with 14 boxes, two experimental diets and seven replicates, by treatment with fourteen birds per experimental unit. The variables analyzed were: feed intake; egg production; egg mass: feed conversion per egg mass; feed conversion per dozen eggs; egg weight; albumen weight; yolk weight; shell weight; yolk percentage; albumen percentage shell percentage; yolk pigmentation and the presence of endoparasites. No influence ($p > 0.05$) were found, for performance and egg production, in Carijó laying hens fed supplemented with banana leaf in natura. For the treatment with inclusion of banana leaf, yolk pigmentation were superior ($p < 0.05$) when compared to control diet, producing eggs with more yolks orange color. In respect to endoparasite analysis, there was significant effect ($p < 0.05$) in the percentage of infections present in excretas. Among the treatments evaluated, the one with banana leaf supplementation reduced in 26.54% the endoparasites presence. The inclusion of banana leaf in the diet of Carijo laying hens does not affect performance and eggs quality and decreases the amount of endoparasites of the genus *Strogyloides spp*.

Keywords: banana production; Cage-Free; endoparasites; performance.

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Introduction

Brazilian poultry is one of the leading animal production agriculture industries, becoming an example of activity and productive chain of success. Production costs related to food in this segment has generated relevant concerns for industry and poultry producers, since production cost affects directly in the final profitability (Rufino, Cruz, Tanaka, Melo, & Feijó, 2017). The increase of corn and soybean prices or their low availability has encouraged the research, looking for alternative foods reducing poultry production costs, without harming animal performance (Lopes et al., 2014).

According to Diniz, Granja-Salcedo, Oliveira and Viegas (2014), banana (*Musa spp*) cultivation has grown considerably in the last three decades, together with soil improvement and the country climatic characteristics favoring its production, this crop shows rapid economic return on invested capital since the production begin can occur the first year, and for being a perennial crop with continuous flow, for that, becoming attractive to farmers.

Bezerra, Sousa and Oliveira (2002) reported that banana tree nutritional composition varies according to the variety, age and plant component, and the leaf can have 12 to 13% protein in the dry matter. The banana is still rich in organic pigment beta-carotene, which can confer more orange color to yolk, also can be used as a prophylactic agent and precursor of vitamin A.

Carotenoid pigments are normally found in vegetables, and are responsible for feathers, skin and egg yolk pigmentation. Yellow coloration is typical effected by carotenes (Mendonça, Correa, Benevides, Mota & Franca, 2018). Another benefit of plant extracts regards the natural anthelmintic capacity (Soares, Welter, Gonzaga, Alessandro, Mancini-Filho & Roseane, 2008). Vegetable extracts are available in nature and they are easy to reproduce and plant, although they are less expensive compared to other nutritional fonts.

Researchers found positive results of using plants in the control of helminthes, enabling to decrease in the parasite load in extensive poultry, obtaining high quality products with lower costs and increasing the poultry producer profitability (Fernandes, Rodrigues, Borba, Fernandes & Amorim, 2004).

Thus, this research aimed to evaluate the use of banana leaf provided *in natura* as supplementation in the diet and its influence on productive performance, egg quality and the endoparasites presence on Carijó laying hens raised in *Cage Free* system.

Material and methods

The experiment was conducted in the Federal University of Mato Grosso (UFMT), in the Poultry Sector of the Experimental Farm located in Santo Antônio municipality – Leverger. The project was submitted, analyzed and approved by the ethics committee on the use of animals (CEUA) under number 23108.092960/2015-80.

In this context, 196 Carijó laying hens with twenty four weeks of age, 2.235 kg of live weight (LW) and 69% of posture rate, were distributed in a completely randomized design with seven experimental units (EU) as replicates and fourteen birds per EU. The birds were fed with experimental diet (Table 1), which was based on corn and soybean meal, formulated as recommended by Rostagno et al. (2011) for semi-heavy birds adding, as supplementation, banana leaf *in natura*.

The experiment lasted 63 days, divided in three periods of 21 days each. All birds were weighed at the beginning and end of the experiment to determine body weight (BW) variation. The birds were housed in experimental masonry shed, with ceramic tile roof, concrete floor, side walls screened with external protective curtain, equipped with sprinklers and fans.

The 14 experimental boxes used were 2.22 m wide and 3.27 m long, totaling 7.25 m^2, with 14 birds in each box, obtaining a housing density of 1.93 bird's m^{-2}. The birds of both treatments were fed with a basal diet provided twice a day in the morning and afternoon, and a treatment was supplemented with fresh banana leaf during whole experiment.

The banana leaf were collected every morning in the fruit sector of the UFMT experimental farm and taken to the shed where the birds were housed, after which they were processed by a leaf shredder to make the particles smaller after this was weighed 570 g per experimental boxing corresponding to 40g per bird housed and supplied in feeders for that purpose. Next day in the morning the leftovers were removed and weighed, thus being able to estimate the actual consumption of the banana leaf *in natura*. The lighting program adopted during the entire experimental phase was 16 hours of light per day.

Performance

The feed intake (FI) was obtained through the amount of feed offered during whole experimental period and discarded leftovers at the end of the experimental period divided by the number of birds of each treatment and then divided by sixty-three days expressed in grams of consumed feed bird day^{-1}.

Table 1. Percentage and calculated composition of the diet.

Ingredients	Value
Ground corn %	62.5
Soybean meal %	25.0
Nucleus[1] %	1.5
Dicalcium phosphate %	1.1
Calcic limestone %	7.6
Common Salt %	0.5
Oil %	1.8
Nutrition composition calculated	
Metabolizable energy (kcal kg^{-1})	2900
Crude protein%	16.02
Calcium %	3.90
Available phosphorus %	0.291
Sodium %	0.218
Digestible Lysine %	0.777
Methionine + cystine Digestible %	0.707
Digestible Threonine %	0.591
Digestible Tryptophan %	0.179

[1]Guarantee level per kg of core, Calcium (max) 210g.; Calcium (min) 170g.; Phosphorus (min) 45g.; Methionine (min) 10g.; Vitamin A (min) 140000 IU.; Vitamin D3 (min) 35000 IU.; Vitamin E (min) 140 IU.; Thiamine (B1) (min) 10 mg.; Riboflavin (B2) 20 mg.; Vitamin B12 (min) 120 mcg.; Vitamin K3 (min) 30 mg.; Folic Acid (min) 6 Mg.; Niacin (min) 300 mg.; Calcium Pantothenate (min) 120 mg.; (Min) 6 mg.; Iron (min) 630 mg.; Iodine (min) 20 mg.; Selenium (min) 6 mg.; Sodium (min) 30 g.; Manganese (min) 1600 mg.; Zinc (min) 1300 mg.; Copper (min) 10000 FTU and Zinc Bacitracin 500 mg.

The feed conversion per egg mass (FCEM) was obtained by dividing FI in kilograms by the egg mass (EM) produced in kilograms (kg kg^{-1}), during the entire experimental period.

Feed conversion per dozen eggs (FC12E) was expressed as the total feed consumption in kilograms divided by the dozen eggs produced (kg dz^{-1}).

To analyze egg production (EP), they were collected and recorded daily. After that, the values were transformed in percentage, adding the yields per repetition of each period and divided by the total amount of days of the experiment, that is 63 days, and then divided by 14, number of experimental repetitions, obtaining the average production (%) in each period.

Eggs quality

All intact eggs produced at the end of each experimental period consisting of 21 days were collected and afterwards, three eggs were randomly selected from each replicate to perform egg quality analyzes daily for three consecutive days and weighed in a precision scale of 0.01 g. The mean egg weight (EW) in grams was obtained by weighing the eggs. After weighed individually, the eggs were broken and then the yolk weight (YW) in grams. The shells were washed and air dried for two days to obtain shell weight (BW) in grams. Finally, the albumen weight (AW) was obtained by subtracting the EW and YW in grams. The percentage (%) in composition of the egg, was composed by EW considered as 100% and the other egg measures were divided by it to obtain its respective percentage as yolk (Y%), albumen (A%) and shell (B%) percentage.

In order to analyze the color of the yolk, a colorimetric tool DSM 14 tons was used to obtain yolk pigmentation (YP) which varies from opaque yellow to intense orange, the higher the score value obtained in the fan, the greater the degree of pigmentation of the yolk. The three samples of each repetition were placed on a flat surface, the colorimetric tool was placed above the buds, and it was possible to observe the staining according to the colorimetric tool scale, these analyzes were always performed by the same person from the beginning to the end of the experiment, always in the same place and daytime, in order to avoid variations, mainly for being a subjective analysis, and thus calculated the average per period.

The specific gravity of the eggs was evaluated from collected intact eggs, which were properly identified according to the treatment and repetition, were immersed and evaluated in NaCl solutions with density varying from 1.070 to 1.095 g cm^{-3}. The density was measured and confirmed with the aid of a floating glass densitometer specific for salinity, according to the method suggested by Hamilton (1982), after immersing the eggs that corresponded to the specified density fluctuated, then the value was recorded manually in worksheets.

Presence of endoparasites

Excreta samples were collected on the last day of the experimental period in the morning. The excreta were collected with the aid of wooden spatulas without touching the floor and stored in specific plastic pots for analysis and packed in iceboxes. Subsequently they were transported to the Laboratory. Three samples of each replicate were used for analyzes. The analysis for endoparasite presence was performed using Willis (1921) method, at the UFMT - Medicine Veterinary Hospital, Animal Parasitology Laboratory, with the principle of fluctuation through a high density NaCl solution, to which the eggs adhere to the lower surface of the slide followed by direct qualitative microscopic analysis after excreta concentration. Parasites nematodes and cestodes eggs and larvae, and oocysts of *Eimeriidae* and *Strongyloidea* families were observed.

Statistical analysis

The variables statistical analysis was performed by the Assistat Statistical Program (Silva & Azevedo, 2002). Performance bird's means were compared using the F Test, while the means of endoparasite presence (%) were compare whitin with SNK test. Both performance and endoparasite presence were analyzed with 5% probability level.

Results and discussion

There was no significant influence ($p > 0.05$) on productive performance and egg quality of Carijo laying hens supplemented with banana leaf *in natura* in the diet (Table 2). The daily addition of banana leaf did not influence ($p < 0.05$) FI, EP, EM, EM, FC12E, YW, BW, AW, Y%, B% and A%.

Table 2. Performance of Carijó laying hens due to dietary supplementation with banana leaf. Control diet (CD) (Diet based on corn and soybean meal); Supplementation diet (SD) (Diet based on corn and soybean meal + supply of banana leaf *in natura*).

Variables	CD	SD	p-value	C.V. (%)
FI (g bird day^{-1})	0.173	0.171	0.087	1.55
Banana leaf consumption (g bird day^{-1})*	0.0	40.7	----	-----
EP (%)	57.74	52.52	0.054	9.31
EW (g)	64.25	64.99	0.089	1.34
EM (g bird day^{-1})	32.72	30.68	0.006	9.43
FCEM (kg kg^{-1})	4.64	4.89	0.0078	8.92
FC12E (kg dz^{-1})	3.57	3.82	0.34	8.87
YW (g)	19.26	19.65	0.21	2.08
BW (g)	5.83	5.86	0.075	1.77
AW (g)	39.27	39.54	0.26	1.55
YP **	4.78^{b}	6.99^{a}	0.0002	3.95
Y%	29.98	30.24	0.056	1.55
B%	9.08	9.02	0.067	1.39
A%	61.12	60.83	0.074	0.71
Live weight variation (g)*	388.0	410.0	---	---

FI: feed intake; EP: egg production; EM: egg mass; FCEM: feed conversion per egg mass; FC12E: Feed conversion per dozen eggs; EW: The mean egg weight; YW: yolk weight; BW: shell weight in grams; AW: albumen weight in grams; YP: yolk pigmentation; Y%: yolk percentage; A%: albumen percentage and B%: shell percentage. ^{ns} No statistical significance by F test ($p > 0.05$). Means followed by the same letter on the line do not differ at the 5% level of significance. *Descriptive analysis. **Statistical significance with 1% probability level.

The addition of banana leaf *in natura* did not alter birds performance ($p > 0.05$), which may be a nutritional complement that benefits other variables, such as the color of the yolk. Significant results were found at the 1% probability level ($p < 0.01$) in the yolk color (Table 2). The treatment based on corn and soybean meal, with the supplementation of fresh leaves provided greater egg yolk pigmentation.

The change in the YP to more orange may be justified by the presence of carotenes in the composition of the banana leaf, such as carotene, which is an organic substance that gives pigment to the plants and when used in poultry, feeding birds in adequate quantities, might help to intensify both bird skin color and egg yolk.

According to Silva, Albino and Souza (2000), YP is an important trait for egg valorization and acceptance by pasta consumers and manufacturers, deserts and other products that have their value maximized by offering more vivid and attractive colors to the consumer. Therefore, foods that may be favored by YP may result in better price to producers.

Foliar residues from banana farming can also be added as fiber source in feed for monogastric animals. Musmanni, Campabadal and Vargas (1979) evaluated biologically and economically the use of different protein levels in pigs fed supplementing banana waste, and concluded that production cost reduced using it.

Marín, Carías, Cioccia and Hevia (2003), in their research using banana leaf in broilers feeding, showed that the treatment with banana leaf provided to the broiler chickens higher growth performance when compared to the other diets containing ingredients derived from legumes.

The data obtained after endoparasite excreta tests (Table 3), showed that Carijo laying hens supplemented with banana leaf dah low load ($p < 0.05$) in percentage of *Strongyloides spp.* and *Eimeira spp.* present in the excreta, compared with the control diet.

In this experiment, parasites of the genus *Strongyloides* spp. and *Eimeria* spp. Were observed, also those were found in Siqueira (2016) research. Although the author has detected genres *Capillaria*, *Heterakis*, *Choanotaenia*, *Ascaridia*, *Stronyloidea*, *Strongyloides* and *Eimeria* protozoan, the birds showed no clinical signs of parasitic infection.

Table 3. Endoparasites presence (%) in excreta of Carijó laying hens due to dietary supplementation with banana leaf. Control diet (CD) (Diet based on corn and soybean meal); Supplementation diet (SD) (Diet based on corn and soybean meal + supply of banana leaf *in natura*).

Variables	CD	SD	*p-value*	CV
Oocytes of *Strogyloides* spp (%)	63.26^{a}	36.73^{b}	0.0034	10.92
Oocytes of *Eimeira* spp*	1	0	----	---

Means followed by different letters in the row differ among themselves at the 5% level of significance by SNK test. *Descriptive analysis.

These data corroborate those found by Silva, Amorim, Santos-Serejo, Ferreira and Rodriguez (2013), which found that banana can be used for feeding cattle in order to deworm the animals, being supplied *in natura* mixed in meal. It is possible to find the presence of seven species of endoparasites in birds raised in intensive systems: the protozoa *Eimeria* sp. and *Entamoeba* sp.; *Nematoda* helminthes *Heterakis gallinarum*, *Strongyllus avium*, *Tetrameres sp*, *Ascaridia galii*; although found a diversity of cestodes.

Gomes, Simões Machado, Lemos, Almeida and Daher (2009) verified the presence of species *Eimeria*, *Hetrakis gallinarium*, *Strongyloides*, and *Ascaridia galii* in bird excreta samples raised in *Cage free* systems. According to Olivo et al. (2007) banana species present tannins in their constitution. These compounds could be responsible for anthelmintic activity, since plants containing tannins are often used in the fight against verminosis.

Acorda, Mangubat and Divina (2019) working with the addition of pumpkin seeds as an alternative natural extracts for laying hens suggested that pumpkin seed has the potential to be used as an alternative anthelmintic for chickens.

From this, banana farming co-products can be used, such as the stem and its leaves. Proving that, this research showed the use of fresh banana leaf as supplementation for feeding Carijo laying hens, leading to the control intestinal endoparasites of the Nematoda class.

Conclusion

Feed supplementation with banana leaf in the diet of Carijó laying hens in *Cage free* system increases yolk pigmentation, does not interfere on performance and reduces the endoparasites presence.

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