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Effects of Supplementation with Powder from Various Medicinal Plants on Productivity and Quality of Eggs from Laying Hens

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ABSTRACT

To evaluate the effect of feed supplementation based on a mixture of from medicinal plants powder (40 % *Psidium guajava* L.; 20 % *Morinda citrifolia* L.) on production and quality of eggs from laying hens, 160 White Leghorn hybrid hens (L-33), 27 weeks old, were grouped in one control group without additives, and three feed supplements for 70 days, following a completely randomized design. The three supplements included a powder mixture (0.5; 1.0; and 1.5 %). The birds showed no morbi-lethality after consuming the complementary diets. Supplementation of 1.0 % of the mixture increased laying intensity (83.93 %). However, egg weight, live weight, feed consumption, rejected eggs, yolk color, and sensorial quality of the yolk and albumin, had significant differences ($P > 0.05$) among the treatments. Supplementation with 1.0 % of the powder increased ($P < 0.05$) the shell thickness (0.27 mm); whereas yolk height and white thickness remained without significant differences ($P > 0.05$). The inclusion of 1.0 % of the mixed powder is recommended in the diet of laying hens to increase egg production and shell thickness.

Keywords:*powder, mixed, addition, layer, production, quality*

INTRODUCTION

Natural products, like prebiotics, probiotics, symbiotics, organic acids, and medicinal plants have been used as diet supplements to growing and production poultry, in order to improve health conditions, reduce pathogens, enhance immune response, and increase production (Martínez *et al*., 2012a; Gong, Yin, Hou and Yin *et al*., 2014).

The use of mixed powders from the leaves of medicinal plants may have an improved biological effect in comparison to single medicinal plants use, based on their synergy and use of the active principles of plants. In that sense, mixed powders have demonstrated to enhance production and health indicators in lab pigs, birds and mice (Kong *et al*., 2004; Kong *et al*., 2007; Gong *et al*.; 2014).

Psidium guajava L. (guava) is native from the tropical areas of the Americas. Its leaves and bark are used as phytopreparates in animals and humans, due to their antibacterial, anti-emetic, anti-inflammatory, anthelminthic, antiseptic, antitoxic, astringent, carminative, spasmodic, and tonic properties (Bontempo *et al*., 2012).

Moringa oleifera Lam.is from the sub-Himalayan region, originally, from the Moringacea family. It has widespread particularly in tropical and subtropical regions. Its leaves have been used to treat infectious and inflammatory diseases, gastrointestinal, hematological and cardiovascular disorders (Abdull, Ahmad, Ibrahim, and Kntayya, 2014).

Anacardium occidentale L.(cashewnut) is a fast-growing tropical tree from South America. Several studies of the plant leaves have found anti-inflammatory, antibacterial, analgesic, anticoagulant, anti-spasmodic, and astringent properties (Martínez *et al*., 2012b).

Morinda citrifolia L. (noni) is a tropical plant of the *Rubiaceae* family, originally from India. It has antibacterial, antiviral, antifungal, antitumoral, analgesic, anti-inflammatory, hypotensor, and immunostimulating properties (Ali, Kenganora, M., and Manjula, 2016).

Despite the preventive and curative properties of the above medicinal plants, no reports have been made on the mixture of their leaves to feed poultry. The aim of this paper was to evaluate the effect of diet supplementation with mixed powder from different medicinal plants (40% *P. guajava*, 20% *M. oleifera*, 20% *M. citriflora*, and 20% *A. occidentale*), on egg quality and production by laying hens, during their production peaks.

MATERIALS AND METHODS

The experiment was made at the Antonio Maceo Poultry Farm, Granma Poultry Company, Bayamo, Granma, Cuba. The mean relative humidity was 72%, and the average minimum and maximum temperatures were 17.3 and 30.1 ºC, respectively. A Deli 9013 hydro-thermograph (China) was used.

Randomly, 20 leaves of *P. guajava*, *M. oleifera*, *A. occidentale*, and *M. citrifolia*, were collected. from suburban areas of the municipality of Bayamo, province of Granma, in a flat area, with carbonated brown soils. The diversity, size and structure of leaves were considered during recollection (Martínez *et al*., 2012a).

The samples were dehydrated for 7 days in the shade, on perforated cardboards, and were moved twice a day. Then, they were placed in an air circulating stove (WSU 400, Germany), for 1 h at 60 ºC, and were crushed in a hammer mill with parallel blade shears (1 mm granulometry to make the mixtures of *P. guajava* (40%), *M. oleifera* (20%), *A. occidentale* (20%), and *M. citrifolia* (20%) (mixed powder). The samples were stored at room temperature in air-tight plastic bags (Yin *et al*., 1993).

A total of 160 hybrid White Leghorn (L-33), 27-week old laying hens (in their laying peaks) were randomly arranged in four treatments, with 10 replicas per treatment and four birds per replica. Isoprotein and isoenergetic diets were made, and a control diet was included without additives, with three supplementation levels (0.5; 1.0; and 5%), containing the mixed powder in phase I. The diets contained corn and soy cake, according to recommendations by UECAN (2011).

The experimental unit was a wire cage (40 X 40 cm), with four hens in each cage. The birds received 110 g of feed/hen/day. Water was supplied ad libitum, through two nipples per cage. Light was supplied for 16 h a day.

The initial and final weights of the laying hens were measured separately, at 27 and 37 weeks of age, using a Sartorius digital scale, BL 1500. The eggs were weighed weekly (20 eggs per treatment), and the mean weight was calculated. The consumption of feed and mixture was determined daily through supply-rejection. To determine the intensity of laying, the total production of egg/week/treatment was estimated; 100% was regarded as one egg/day/caged bird. Feed conversion was calculated considering the feed consumed, egg weight by repetition, and the number of laid eggs. Viability was estimated at the end of the experiment.

The percent of rejected eggs (cracked, membranous shell, and broken) was calculated according to the rejected egg% (UEP) =# UEG* 100/rejected eggs.

In the 37th week, 20 eggs per treatment were sampled to determine the external indicators of quality (egg weight, and shell thickness and surface), and internal indicators (height of thick white and yolk, Haugh units, and yolk color). A Russian gauge meter (± 0.01 mm) was used to measure the thickness of the shell in the equator and the upper and lower poles. The shell surface was determined according to Carter: Area = $3.9782W^{0.7056}$, where W is the egg weight (g). The heights of thick white and yolk were measured with a height gauge meter (Maver). Yolk color was determined by the Roche Scale (15 colors). The Haugh unit values were calculated by the ratio of the egg height and the height of the thick white: HU=100 log [H + 7.57 – 1.7W0.37], where HU is the Haugh units; H is the white height, and W is the weight of egg.

The data were processed through simple variance analysis (Anova), using a completely randomized design. The Duncan´s test was used when necessary to determine the mean differences (SPSS, 12.1, for Windows).

RESULTS AND DISCUSSION

According to table 1, variability did not show significant differences among the treatments ($P > 0.05$), which proved the safety of the product used for 70 days. This result coincides with Ayala, Silvana, Zocarrato and Gómez (2011), who found that phytobiotic products did not affect the conditions of non-ruminant animals. Likewise, feed consumption dropped ($P > 0.05$) by increasing the diet of mixed powders (Table 1). Similar results were found by Martínez *et al*. (2012a) and Más *et al.* (2015), when added the powder of *A.occidentale* in the diet of laying hens.

In that sense, bird weight, feed conversion, egg weight, and percentage of rejected eggs did not vary among the treatments ($P > 0.05$). The secondary metabolites of the plants included in the powder did not cause any symptoms related to anti-nutritional factors; according to Savón, Scull, Orta and Martínez (2007), their excess might diminish body weight and productive behavior.

Furthermore, the laying intensity increased significantly ($P < 0.05$) with the supplementation of 1.0 % of the mixed powder. It demonstrated the effectiveness of secondary metabolites of medicinal plants in the experiment. The synergy of these principles led to these results, previously proved by Kong *et al*. (2004).

In that sense, *P. guajava* is known to have gamma-pyrones with proven antioxidant properties. Also, the mixture of *M. citrifolia*, *M. oleifera* and *A. occidentale*leaves, with anti-inflammatory and antimicrobial effects, favored the production indicator.

Likewise, the cummarins detected (+++) by phytochemical screening in the mixed powder (Más *et al*., 2017) hadbeneficial effects when used in little proportions, and are powerful bactericides and fungicides (Martínez *et al*., 2012b), which was related to intestinal health and nutrient digestibility (mainly essential aminoacids and minerals) (Ghasemi, Zarei and Torki, 2010). Therefore, they have greater laying intensity with the supplementation of 1.0% (Table 1).

However, supplementation with 1.5% did not improve the production indicators, because the excess secondary metabolites in the diet caused adverse reactions as anti-nutritional factors, thus limiting the absorption of biomolecules, minerals and vitamins (Savón *et al*., 2007). In that sense, Más *et al*. (2017) found that supplementation with 1.5% of *Morinda citrifloria* and *Anacardium occidentale* decreased the production behavior of laying hens, respectively, probably due to the high concentrations of secondary metabolites of those plants.

The egg weight, shape index, height of thick white, and height and color of yolks did not show any significant differences among the treatments ($P > 0.05$) (Table 2). Nevertheless, shell thickness increased ($P < 0.05$) with 1.40 % of the mixed powder, compared to the control, the 0.5 and 1.5% of the mixed powder of the medicinal plants in the study. It was caused by greater competitive exclusion and pH decrease in the intestinal tract, which favored calcium absorption, as well as the uptake of calcium ions by the shell during egg formation (Martínez *et al*. 2012a). According to Savón *et al*. (2007)optimal intestinal pH conditions are required due to the mineral´s insolubility and lack of stability.

Previous research demonstrated that supplementation with a single plant may increase color intensity in the yolk. In that sense, Martínez *et al*. (2012a) and Más *et al*. (2015), found that supplementation with *A.occidentale* and *M. citrifolia* colored the egg yolk in comparison to the control, respectively, due to the presence of antocianidins. A synergy of the secondary metabolites in the mixed powder inhibited the action of that natural pigment; however, further studies are necessary to corroborate this hypothesis.

CONCLUSIONS

Supplementation with mixed powder increased the laying intensity and the thickness of shells, without affecting the other indicators studied. The mixed powder is recommendable in the diet of laying hens at 1.0% during their production peaks.

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Table 1. Effect of the mixed powder on the productive behavior of laying hens (27 - 37 weeks old)

Indicators	Mixed powder of medicinal plants(%)				SE±	Sig.
	0	0.50	1.00	1.50		
Viability (%)	100.0	100.0	100.0	100.0	-----	-----
Laying intensity (%)	80.18[b]	78.50[b]	83.93[a]	78.53[b]	0.498	0.003
Feed consumption (g /b/d)	110.0	110.00	110.00	110.00	-----	-----
Mixed powder consumption(g/b/d)	0.00	0.55	1.10	1.65	-----	-----
Consumption of*P. guajava* (g/b/d)	0.00	0.22	0.44	0.66	-----	-----
Consumption of *M. oleifera* (g/b/d)	0.00	0.11	0.22	0.33	-----	-----
Consumption of *M. citrifolia* (g/a/d)	0.00	0.11	0.22	0.33	-----	-----
Consumption of*A. occidentale*(g/b/d)	0.00	0.11	0.22	0.33	-----	-----
Feed conversion (kg/kg)	2.60	2.63	2.46	2.63	0.029	0.147
Egg weight (g)	53.08	53.57	53.29	53.48	0.129	0.542
Initial live weight (g)	1638	1610	1617	1642	15.43	0.549
Final live weight (g)	1667	1683	1637	1657	9.574	0.299
Cracked eggs (%)	0.18	0.11	0.14	0.07	0.067	0.278
broken eggs (%)	0.00	0.14	0.07	0.18	0.059	0.648
Shell membrane egg (%)	0.04	0.04	0.00	0.00	0.025	0.580

[a,b] Means with different letters in the same rows differ from $P < 0.05$

Table 2. Effect of mixed powder on the inner and outer quality of eggs from laying hens (37 weeks old)

Indicators	Mixed powder of medicinal plants (%)				SE±	Sig.
	0	0.5	1.0	1.5		
Egg weight (g)	55.20	53.40	55.80	54.20	0.420	0.231
Shape index (%)	73.75	76.41	75.07	73.61	0.510	0.219
Shell thickness (mm)	0.17[c]	0.23[b]	0.27[a]	0.23[b]	0.003	0.001
Shell surface (cm^2)	44.89	43.86	45.24	44.30	0.240	0.228
Height of thick white (mm)	6.31	5.98	5.93	6.14	0.059	0.122
Height of yolk (mm)	6.93	6.83	7.17	6.96	0.055	0.223
Haugh units	80.47	78.82	77.44	79.70	0.540	0.254
Color of yolk	6	6	6	7	0.100	0.214

[a,b,c]Means with different letters in the same rows differ from $P < 0.05$