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Supplementation Carotenoid Compounds Derived from Seed Integral Ground Annatto (*Bixa orellana* L.) In the Feed Laying Hens to Produce Eggs Special

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Abstract: This research project aimed to evaluate the levels influence of 1.00% (T2), 1.25% (T3), 1.50% (T4) and 1.75% (T5) of the seed ground annatto (SMU) and a sixth control group (T1), all receiving white corn-soybean basal diet, on the productive performance, egg's quality and egg yolk's pigmentation. In this study, one hundred and twenty Label Rouge hens with 32-weeks-old were arranged in a completely randomized design, with five treatments and three replications of the eight birds each other. Effect of annatto carotenoids was assessed on the productive performance and yolk's pigmentation by the colorimetric (LC) and the portable spectrophotometer CM 508d-MINOLTA methods. Layers showed normal parameters of consumption and egg's quality at the ninth week trial, except lower mean to consumption of 99.50 g/bird/day of and egg production of 85.30% in the T5 (1.75%). Mean colour of the LC ranged ($P<0.05$) from 1 (CON) to 11.75 (T5). Objective colour means of yolk *in natura* to L* C* h varied the lowest 16.59% on L* (T1 = 64.44 a T5 = 53.75) tending from the pale to the yellow saturation, the highest 200.41% on C * (T1 = 12.09 a T5 = 36.42) with accentuation of yellow-orange and the highest 186.18% on h to accentuate of the yellow tone. C* increased linearly ($Y = 0.4875x + 12.4830$; $R^2 = 0.95$) in the yolk and was proportional to increase of pigment consumption in the diet, emphasizing the ability of yolk's pigmentation by carotenoid compounds derived from annatto seed.

Key words: Egg yolk color, laying hen, new nutrients, pigmentation, phytonutrient

INTRODUCTION

The implementation of strategies to improve the nutritional composition and quality of food and animal products has recently emerged as an interface of animal science, food science and human nutrition. This approach has been used to change the composition of products in order to be more consistent with the nutritional standards of the human diet. The egg is considered an excellent source of food. Graciously, our cuisine has adopted the egg to be a complete food in nutrients and high consumer acceptance. From the nutritional point of view, the egg is considered ideal target for dietary modification leading to the development of food with functional or nutraceutical properties.

When considering the benefits of improving the quality of eggs in the concentration of various nutrients, especially compounds carotenoids, various studies have been conducted in order to strengthen eggs (Hargis and Van Elswyk, 1993). The food industry has envisioned increasing expansion of products and egg by-products. Alternatively, the oil of egg yolk, by changing the composition of the diet of the hen, can be rich source of natural antioxidant compounds based on carotenoid annatto.

The strategies to meet the increasing demands of natural dyes in the face of restrictions those artificial pigments demonstrated the potential risk to public health have been anchored in decisions of the Committee of Experts of the FAO/WHO (JECFA, 2004).

MATERIALS AND METHODS

The researches were conducted October 2007 to January 2008 in the experimental bird vivarium of the Pathology Laboratory Animal of Bauru and CCQA of ITAL, institutions of APTA-Secretariat of Agriculture Sao Paulo of State. This study used a completely randomized design, using 120 hens Label Rouge with 32 weeks old, marked in five treatments with three replicates of eight birds. Ration was provided ad libitum in trough type feeder and water fountain nipple. Diets were isocaloric and isonitrogenous and were formulated according to NRC (1994). The diets of the treatments were composed of a basal diet of white maize (MB) and soybean, the treatments from two to five diets of white corn, the hens have added levels of 1.00, 1.25, 1.50 and 1.75% of ground annatto seed (SMU) in the diet (Table 1). The analysis of the content of bixin SMU was performed following the method of Carvalho *et al.* (1993). Eggs used for the determination of objective color of fresh buds were harvested in the ninth week. To obtain the color by color fan Roche yolk color fan (LC) were sampled twelve eggs per treatment and after

Table 1: Mean consumption (g/bird/day), feed conversion (kg feed/kg egg and kg feed/dozen egg), Haugh Unit (HU), Specific Gravity (SG), egg weight (g) Index Posture (IP), Thickness (EC) and shell percentage (%), weight and percentage of albumen (%) and yolk (%) and objective color of the yolk fresh in L* C* h yolk eggs from hens

Treatments	T1	T2	T3	T4	T5
SMU in ration	0	1.00	1.25	1.50	1.75
	Annatto carotenoids in the diet (mg/bird/day)				
	0.00^{D}	35.78^{C}	43.51^{B}	50.73^{A}	50.91^{A}
Parameters analyzed	Productive performance and quality of ovo[1]				
g/hen/day	108.67^{A}	106.00^{A}	104.70^{A}	104.30^{A}	99.50^{B}
Kg rat./kg egg	2.06^{A}	2.01^{A}	2.08^{A}	1.99^{A}	2.10^{A}
Kg rat./doz. egg	1.43^{A}	1.50^{A}	1.55^{A}	1.51^{A}	1.62^{B}
UH	90.25^{B}	98.58^{A}	97.72^{A}	95.30^{A}	96.80^{A}
GE (g/L)	1.092^{A}	1.092^{A}	1.090^{A}	1.091^{A}	1.093^{A}
Egg weight (g)	61.92^{A}	59.85^{A}	60.10^{A}	59.98^{A}	59.79^{A}
IP (%)	91.07^{A}	87.90^{A}	88.50^{A}	89.55^{A}	85.30^{B}
EC (mm)	0.3963^{A}	0.3982^{A}	0.3817^{A}	0.3899^{A}	0.3895^{A}
PC (g)	6.38^{A}	6.63^{A}	6.52^{A}	6.24^{A}	6.40^{A}
Egg shell (%)	10.30^{A}	10.93^{A}	10.28^{A}	10.05^{A}	10.41^{A}
Albúmen (g)	39.17^{A}	37.93^{A}	38.90^{A}	39.50^{A}	39.83^{A}
Albúmen (%)	63.23^{A}	62.31^{A}	62.90^{A}	62.67^{A}	62.79^{A}
Yolk (g)	16.38^{A}	17.68^{A}	17.01^{A}	17.10^{A}	17.30^{A}
Yolk (%)	26.46^{A}	28.90^{A}	26.79^{A}	27.98^{A}	26.97^{A}
Color score[2]	1.00^{D}	8.25^{C}	8.75^{CB}	10.25^{B}	11.75^{A}
	Color objective gem fresh thrust in L* C* h[3]				
L*	64.44^{A}±0.88	56.58^{AB}±2.43	57.85^{AB}±5.54	53.54^{B}±0.81	53.75^{B}±3.35
C*	12.09^{B}±0.38	32.87^{A}±4.40	30.33^{A}±6.31	39.00^{A}±4.81	36.32^{A}±5.17
h	-78.78^{C}±1.20	74.13^{A}±1.92	76.96^{A}±6.90	69.61^{AB}±3.17	67.89^{B}±4.04

Chemical composition determined from SMU (%)[4.a]

M.S	P.B	F.B	E.E	M.M	BIXIN	N.D.T	E.Ñ.N
92.43	14.27	13.84	3.35	5.25	2.44	71.91	63.29

[1]Means with different letters in the row differ (P<0.05) significantly by Tukey test. [2]Fan colorimetric Roche yolk color fan. [3]L* C* h: Mean ± standard deviation. [4]MS = Dry Matter; CP = Crude Protein; FB = Crude Fiber; EE = Ether Extract; MM = Mineral Matter; TDN = Total Digestible Nutrients (estimated); NFE = Nitrogen Free Extract. The gross energy determined in SMU = 4496.97 cal/g

broken, the contents were exposed uniformly in a petri dish in an environment with fluorescent lighting and the score of yolk color was obtained by individual four trained evaluators. We used portable spectrophotometer CM 508D - MINOLTA and CIELAB system, illuminant D65, illumination angle 10, with results expressed in the axial coordinate L* (lightness), C* (chromaticity) and h (hue). Statistical analysis used the SAS (1994) and for comparisons between the means was applied Tukey test, adopting a level of 5%.

RESULTS AND DISCUSSION

Treatments supplemented with levels of 1.00-1.50% in the diet of the SMU-based MB did not influence the consumption of hens compared to an average of 108.67 g/bird/day in control group (T1), except reduction in average 99.50 g/bird/day consumption of T5. Production parameters kg feed/kg egg, kg feed/dozen egg laying rate and were not influenced by treatments, except the mean of 1.60 (kg/dz) and 85.30% (PI) in group 5 showed decreases significant compared to other treatments (Table 1). The parameters of internal and external quality of the egg were not affected by treatments in agreement with that reported by Arraya *et al.* (1977) who reported the use of 1.06% of full seed in the diet of laying hens in order to increase the pigmentation of egg yolks.

Yolk color evaluated by LC medium showed significantly increased (P<0.05) 8.25 (T2) to 11.75 (T5) between treatments when compared to an average of 1.00 obtained in the control (T1), showing the efficiency of annatto carotenoids in egg yolk (Table 1).

The analysis of objective color of yolk fresh in L* C* h showed evidence (P<0.05) among the treatments. The average color of the gem objective in nature in axial coordinates L* C* h varied (P<0.05) to 16.59% lower in L* (T1-T5 = 64.44 = 53.75) tend to pale the saturation of the color yellow, the higher 200.41% in C* (T1-T5 = 12.09 = 36.42) with accentuation of the yellow-orange and, most 186.18% in h (T1 = -78.78 to T5 = 67.89) with a more intense yellow, confirming the potential of annatto carotenoids in egg yolks and fortified increases (P<0.05) increased significantly in color, via transfer of pigments from the diet to the egg (Fig. 1).

The regression equations predicted that: L* yolk decreased linearly ($Y = 0.2015x + 64.5240$, $R^2 = 0.93$) with increasing consumption of pigments of annatto in the diet, C* increased linearly in the yolk ($Y = 0.4875x + 12.4830$, $R^2 = 0.95$) in proportion to the increase in consumption of pigment in the feed h: showed accentuation of the yellow hue (cubic regression: $Y = -0.0002x^3 - 0.0736x^2 + 7.1667x - 78.78$, $R^2 = 0.99$) yolk to limit intake of approximately 45 mg/hen/day of pigment present in 1.25% of SMU (Fig. 2). The results of this

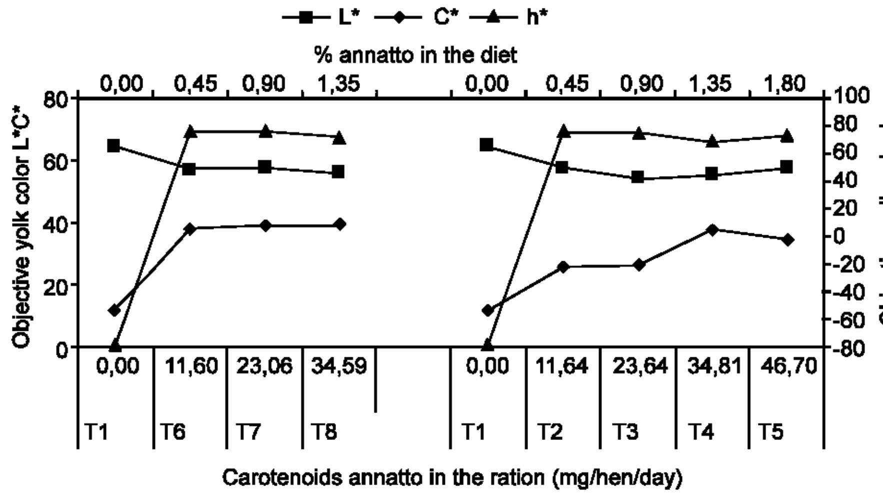

Fig. 1: Variation of the average color of the gem objective L* C* h according to concentrations and consumption of carotenoids from annatto in treatments studied

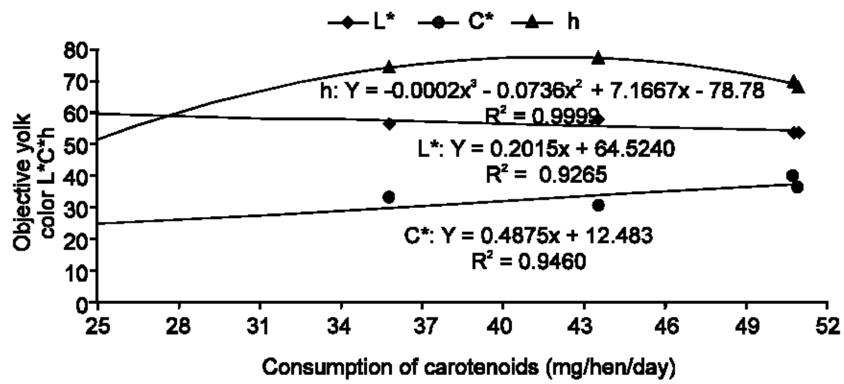

Fig. 2: Variation of the means color of the yolk egg objective L * C * h according to the concentrations and consumption of carotenoids from annatto to the treatments studied

study projected the magnitude of incorporation of the carotenoid annatto from diet to yolk, confirming reports of Marusich and Bauernfeind (1981) to mention that the complex micelles of fatty acids and carotenoids formed in the light of the small intestine by the action of digestive juices and bile salts and are absorbed by passive diffusion. Chylomicrons in the enterocytes containing esters of carotenoids are transported by the lymphatic ducts to the liver. By intense hormonal action of estrogens in the ovary after hepatocytes or resynthesized and conjugated lipoproteins, carotenoids are carried to the target tissue and specific membrane receptors on the cell wall, are incorporated into the hen oocyte.

According to the authors above, the diet lacking carotenoids your pet may be predisposed to oxidative stress of tissues in view of numerous biochemical functions they play in the animal organism. Abundant reserves of these compounds in tissues and products (yolk) are protective mechanisms and would supply the increased demands in certain physiological states preementes with increasing requirements, embryonic.

Conclusion: Additional levels of carotenoids from annatto in the diet of laying hens stood out by increased pigmentation of the buds. The parameters of external and internal quality of eggs were significantly influenced in the context of better quality and color attributes of enriched eggs and special.

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REFERENCES

Arraya, H.H., M.R. Murillo and E.G. Vargas, 1977. Composicion y empleo del achiote (*Bixa orellana* L.) en raciones para gallinas ponedoras, para la pigmentacion de la yema del huevo. Agronômica Costariquense, 1: 143-150.

Carvalho, P.R.N., M.G. Silva and C.G. Moreira, 1993. Avaliação dos métodos espectrofotométricos de análise de sementes de urucum (*Bixa orellana* L.). Coletânia do ITAL, Campinas, 23: 181-188.

Hargis, P.S. and M.E. Van Elswyk, 1993. Manipulating the fatty acid composition of poultry meat and eggs for the health conscious consumer. World's Poultry Sci. J., 49: 251-264.

JECFA, Joint FAO/WHO Expert Committee on Food Additives, 2004. Sixty-first report of the Joint FAO/WHO Expert Committee on Food Additives. Evaluation of certain food additives and contaminants. World Health Organization, Geneva, WHO Technical Report Series, No. 922.

Marusich, W.L. and J.C. Bauernfeind, 1981. Oxycarotenoids in poultry feeds. In: J.C. Bauernfeind (Ed.). Carotenoids as colorants and vitamin A precursors: Technological and nutritional applications. New York: Academic Press. pp: 319-462.

NRC, National Research Council, 1994. Nutrient requirements of poultry, 9th Edn., Washington: National Academy of Sciences, pp: 155.

SAS Institute, 1994. SAS®/STAT. User's Guide: Statistical version. Cary, NC: SAS Institute.