INTERNATIONAL SEVEN
MULTIDISCIPLINARY JOURNAL
ISSN: 2764-9547

Colorimetry profile of fresh broiler breast meat *in natura* fed with cinnamon, oregano and annatto

Perfil da colorimetria do peito de carnes de frangos de corte *in natura* alimentados com canela, orégano e urucum

DOI: 10.56238/isevmjv2n1-006
Recebimento dos originais: 03/02/2023
Aceitação para publicação: 27/02/2023

Alana Maria Barbosa Melo
Zootechnics undergraduate student at Instituto Federal Goiano - Campus Rio Verde
E-mail: mariaalanab21@gmail.com

Ana Maria Vilas Boas Morais
Zootechnics undergraduate student at Instituto Federal Goiano - Campus Rio Verde
E-mail: anamariavbm@outlook.com

Stéfane Alves Sampaio
Master in Zootechnics by Instituto Federal de Educação Ciência e Tecnologia Goiano - Campus Rio Verde
E-mail: stefanesamp@gmail.com

Ludmilla Faria dos Santos
Master in Zootechnics, Veterinarian by Unirv- Campus Rio Verde
E-mail: vetludmilla@gmail.com

Nadielli Pereira Bonifácio
MSc student in Zootechnics at Instituto Federal Goiano - Campus Rio Verde
Medicina Veterinária pela UNIRV- Rio Verde
E-mail: nadielli@yahoo.com.br

Adelir José Santos
MSc student in Zootechnics at Instituto Federal Goiano - Campus Rio Verde
Ciências Econômicas pela Unirv - Campus Rio Verde
E-mail: adelir.jsantos@gmail.com

Camila Ferreira Rezende
MSc student in Zootechnics at Instituto Federal Goiano - Campus Rio Verde
Medicina Veterinária pela UFG - Goiânia
E-mail: camilagyn_88@hotmail.com

Marcello Borges Estevão
MSc student in Zootechnics at Instituto Federal Goiano - Campus Rio Verde
Veterinary Medicine by UNIPAC - Uberlândia
E-mail: marcello_estevao@hotmail.com

INTERNATIONAL SEVEN
MULTIDISCIPLINARY JOURNAL
ISSN: 2764-9547

Fabiana Ramos dos Santos
PhD in Animal Science
E-mail: fabiana.santos@ifgoiano.edu.br

Cibele Silva Minafra
PhD in Agricultural Biochemistry
E-mail: cibele.minafra@ifgoiano.edu.br

ABSTRACT
The objective was to evaluate the effect of including 2% cinnamon powder, dehydrated oregano and annatto powder in the feed of broilers at 42 days of age, on the colorimetry of broiler breasts at 42 days of age. The experimental design was entirely randomized, with four treatments and seven repetitions of ten birds. At 42 days of age, the breast was collected for color evaluation. Thus, it is concluded that the inclusion of phytogenic additives as pigment present in the diet of broilers at 42 days of age influenced the color quality, the cinnamon differed significantly in chroma L* and a* of the control meat, showing better brightness and color tending towards red, improving the aspects of chicken meat for consumers.

Key-words: *Cinnamomum*, *Origanum*, *Bixa orellana*, Poultry, Colorimetry.

1 INTRODUCTION

Poultry farming in Brazil is one of the agricultural activities of greater evolution in recent decades, making the country the third producer and the largest exporter of chicken meat. In the ranking of Main Products Exported in the year 2021, chicken meat stood out in 7th position, with a share of 2.48% in total exports (BUENO, 2022)

The color of meat is the most important quality attribute that influences the acceptability of meat products by consumers, and is therefore a decisive factor at the time of purchase (PIZATO, 2011). The color of chicken breast meat in natura can vary according to several factors, such as the age of the bird, the feed, the slaughter process, among others. Generally, the color of chicken breast meat in natura varies from a pinkish-white to a more yellowish tone. For consumers, the appearance of the meat, texture, color, aroma, taste and juiciness are the main factors that influence their decision to buy a particular cut (Karlovi et al., 2009).

Consumers are able to differentiate raw chicken meat with PSE characteristics, rejecting it and preferring "normal" meat. (DROVAL,2012). The meat products industry has the challenge of offering soft, juicy products, with pleasant color and flavor. (GAYA; FERRAZ, 2006). To ensure all the quality parameters that meet consumer demand it is extremely important to know about the factors and problems that affect the quality of meat. The PSE syndrome, acronym in English for pale, soft, exudative, decreases the quality of chicken meat and limits its economic value. (ZHAO et al., 2016).

Phytogenic additives are substances derived from plants that have a positive effect on the production and health of animals, and give rise to products such as essential oil, plant extract and resin oil (FERNANDES, et al. 2015).

The cinnamon (*Cinnamomum zeylanicum*) has Asian origin and presents cinnamaldehyde as the most abundant active ingredient, which has antimicrobial, antifungal activity, also acting in the stimulation of digestive enzymes(HAMEED, el al., 2016).

The oregano (*Origanum vulgare L.*) is considered an important source of phenolic compounds, which have the ability to slow lipid oxidation, because they act by sequestering free radicals (PRETE et al., 2020).

One of the main pigments for natural yolk coloring used in Brazil is derived from annatto (*Bixa orellana L.*) (MOURA et al., 2011). The annatto colorant responsible for the colorations ranging from yellow to red is bixin (C25H30O4), a diapo-carotenoid, represented by the central part of the molecule of a carotenoid, without the terminal rings (STRINGHETA & SILVA, 2008).

The color of meat is the most important quality attribute that influences the acceptability of meat products by the consumer, because it is a characteristic that influences both the initial choice of the product by the consumer and the acceptance at the time of consumption. The conditions and condition of the animals can affect the color of the meat (SELANI, 2010).

Consumers evaluate products visually, so there is great interest in studying color and brightness of chicken breast meat. LE-BIHAN-DUVAL et al. (2001), showed in their work an important role of genetics in controlling the color of chicken breast meat.

The objective of this study was to evaluate the colorimetry of chicken breast meat *in natura* from chickens fed with 2% added oregano, annatto and cinnamon in the feed.

2 MATERIAL AND METHODS

The experiment was conducted at the Instituto Federal Goiano Campus Rio Verde. The research project was approved by the IACUCU under protocol 8605090419. The experiment lasted 42 days. The experimental design used was entirely randomized, with four treatments and seven repetitions with 10 birds each, totaling 280 Cobb day-old mixed flock chicks housed in galvanized wire cages with dimensions of 0.90m x 0.60m x 0x45m.

The diet formulation consisted of feed produced according to the recommendations of (ROSTAGNO et al., 2017). Separated into four treatment phases. With feed and water supply, *ad libitium*. According to Table 1.

The control feed was composed of soybean meal and corn. 2% was added to the control rations, cinnamon powder, dehydrated oregano and urucum powder for the other treatments.

On day 42 one bird from each repetition, with the average weight of the experimental plot, was separated for an 8 hour fast. At the end of fasting, it was euthanized by cervical dislocation and blood was collected.

The colorimeter is an instrument that allows the objective characterization of colored samples in terms of their color characteristics. One of the most commonly used color spaces in colorimeter color measurement is the Lab* space, created after the theory of opposite colors, where two colors cannot be green and red at the same time, or yellow and blue at the same time. This color space is defined by the coordinates L*, a* and b*, where L* is the luminosity and a* and b* are the chromaticity coordinates. The a* value represents the red/green coordinate, where a indicates red and -a indicates green, and the b* value represents the yellow/blue coordinate, where b indicates yellow and -b indicates blue. The color of the samples was evaluated using a Minolta colorimeter, model Chroma meter, CR400.

The readings were made for the three samples of chicken breast meat in natura of each treatment, obtaining 30 points for each sample repetition, being determined the parameters L * (luminosity), chroma a* and b*. The c* parameter represents color saturation, with higher c* values indicating more saturated colors.

The data were submitted to variance analysis using the SISVAR 5.6 (FERREIRA,2014) program and the means were compared using the F test at 5% probability.

Table 1 - composition of the experimental rations.

Ingredients (Kg)	Pre-Initial (1-7 dias)	Initial (8-21 dias)	Growth (22-35 dias)	Final (36-42 dias)
Corn	55.30	56.02	61.40	67.00
Soybean meal 45%	37.37	35.93	30.20	24.90
Soybean oil	0.80	1.70	2.90	2.80
Dicalcium Phosphate	0.06	1.25	1.48	1.10
Premix 2	1.00[1]	1.00[1]	0.80[2]	1.20[2]
Common salt	0.50	0.49	0.48	0.45
DL-Methionine	0.26	0.50	0.29	0.20
L-Lysine	0.30	0.27	0.22	0.40
Limestone	2.2	1.20	0.19	0.20
L-Threonine	0.19	0.07	0.10	0.07
Inert 1	2.00	2.00	2.00	2.00
Total	100.0	100.0	100.0	100.0

Calculated levels				
Metabolic Energy (Kcal/Kg)	3000.00	3100.0	3147.54	3201.18
Raw Protein (%)	25.31	24.50	20.64	18.68
Lysine dig (%)	1.36	1.31	1.12	1.14
Methionine dig (%)	0.55	0.53	0.58	0.46
Phosphorus disp. (%)	0.48	0.43	0.33	0.28
Calcium (%)	1.01	0.84	0.75	0.66
Sodium (%)	0.23	0.21	0.20	0.19

1 Replacement of the inert with cinnamon, oregano and urucum.
2 Vitamin-mineral Premix (Nutritional Levels per kilo of product): Methionine (Min): 290 g/kg, Iron (Min): 5000 mg/kg, Copper (Min): 1500 mg/kg, Manganese (Min): 14 g/kg, Zinc (Min): 12 g/kg, Iodine (Min): 28 mg/kg, Selenium (Min) 70 mg/kg, Vitamin A (Min): 1500000 IU/kg, Vitamin D3 (Min): 500000 IU/kg, Vitamin E (Min): 3333 IU/kg, Vitamin K3 (Min): 250 mg/kg, Vitamin B1 (Min): 300 mg/kg, Vitamin B2 (Min): 1000 mg/kg, Vitamin B6 (Min): 500 mg/kg, Vitamin B12 (Min) 3333 mcg/kg, Niacin (Min): 6667 mg/kg, Calcium Pantothenate (Min): 2000 mg/kg, Folic Acid (Min): 280 mg/kg Biotin (Min): 8. 3 mg/kg, Choline Chloride (Min): 70 mg/kg.
2 Vitamin Mineral Premix (Nutritional Levels per kilo of product) -Methionine (Min): 300 g/kg, Iron (Min): 6000 mg/kg, Copper (Min): 1850 mg/kg, Manganese (Min): 16.8 g/kg, Zinc (Min): 14. 5 g/kg, Iodine (Min): 330 mg/kg, Selenium (Min) 84 mg/kg, Vitamin A (Min): 1500000 IU/kg, Vitamin D3 (Min): 500000 IU/kg, Vitamin E (Min): 3600 IU/kg, Vitamin K3 (Min): 240 mg/kg, Vitamin B1 (Min): 300 mg/kg, Vitamin B2 (Min): 1100 mg/kg, Vitamin B6 (Min): 500 mg/kg, Vitamin B12 (Min) 3600 mcg/kg, Niacin (Min): 7000 mg/kg, Calcium Pantothenate (Min): 2000 mg/kg, Folic Acid (Min): 320 mg/kg Biotin (Min): 6 mg/kg, Choline Chloride (Min): 65 mg/kg.

3 RESULTS AND DISCUSSIONS

The colorimetry of the additives used in the feed is shown in table 3. These data were obtained from averages of the variables used showing the L*, a*, b* values of cinnamon, oregano and annatto, it can be observed that the chroma a* that reads the red color is higher in the annatto.

Table 2. Colorimetry analysis of the additives used in the cinnamon, oregano and annatto feeds.

	L*	**a***	**b***
Cinnamon	29,20 ± 0,941	7,92 ± 0,254	18,22 ± 0,485
Oregano	11,20 ± 0,421	0,11 ± 0,003	13,22 ± 0,340
Annatto	28,80 ± 0,707	31,56 ± 0,607	37,59 ± 1,128

Table 3 shows the colorimetric values of chicken meat *in natura* from broilers, fed with corn and soybean meal rations with the inclusion of 2% cinnamon, oregano and annatto.

Table 3. Colorimetric analysis of the breast color of broilers fed a corn and soybean meal based diet with inclusion of 2% cinnamon, oregano and annatto.

	L*	a*	b*
Control	54,501a	7,55 b	19,012
Cinnamon	46,920b	11,158 a	18,738
Oregano	54,744a	7,748 b	18,742
Annatto	51,730a	10,272 ab	18,194
		Probability	
CV*	5,32	20,43	14,94
P value	0,0000	0,0022	0,9558
Standard Error	1,045	0,7089	1,0541

CV= coefficient of variation L * = luminosity; a* = red color tendency; b * = yellow color tendency and c* = color saturation. Different letters in the columns differ using Tukey's test.

There was no statistical differentiation for the b* variable. However, there was differentiation for the variables L* and a*.

For the luminosity (L*) there was a differentiation in the color quality of the meat *in natura* from the control, oregano and annatto treatments to the cinnamon treatment, showing that the cinnamon sample made the meat lighter.

For the chroma a*, the samples that presented less red color of the meat in natura, were control and the treatment with oregano, which corroborates with the colors of the phytogenic additives.

In the food industry, L* a* b* colorimetry can be used to evaluate the quality and freshness of fresh chicken meat. By measuring the color of chicken meat in natura, it is possible to evaluate the quality and freshness of the product, as well as detect possible changes in color caused by deterioration or oxidation processes.

According to Passos (2020), the inclusion of 5% urucum bran in chicken feed was not enough to affect the coloration of the chicken breast meat. This result was similar and confirms the results of Harder et al. (2010) and Parente et al. (2018), who tested diets using up to 3% urucum bran with no pigmentation effect in chicken breasts. Differing from this study, that there is differentiation of the control for meat of chickens fed cinnamon and oregano.

According to Silva et al. (2017), when using herb salt, the values found for breast of meat in natura without the addition of herb salt was L*: 52.34, a*:-1.28, b*:11.10. This study also differs from this study in chroma a*, staying similar with the L* and b* values.

These values may differ according to the colorimeter brand and its calibration. However, in the industry the closest values would be with the meat from the treatments, control and with oregano.

However, a new meat study will be done, focused on the market and its acceptability by consumers, since these meats with these treatments are not usually found in the supermarket. But we can see that there are differentiations in the colors.

4 FINAL CONSIDERATIONS

In this work, we showed a colorimetry profile of fresh broiler breast meat *in natura* fed 2% oregano L*54.774, a* 7.748, b* 18.742, cinnamon L*46.920, a*11.158, b*18.738 and annatto L* 51.730, a* 10.272, b* 18.194. Cinnamon differed significantly in the L* and a* chromes from the control meat, showing better luminosity and color tending towards red.

REFERENCES

BUENO, S. **Exportação da carne de frango**. 2022. Disponível em: https: //www:fazcomex:com:br/comex/exportacao-de-carne-de-frango/#:~:text=Exporta%C3% A7%C3%A3o%20da%20carne%20de%20frango. Acesso em: 09/05/2023

DROVAL, A. A. **Carnes PSE (Pale, Soft, Exudative) em frango: Avaliação de parâmetros físicos e sensoriais e análise de polimorfismos em regiões específicas do gene alfa-RyR**. Tese (Doutorado em Ciência de Alimentos) - Departamento de Ciência e Tecnologia de Alimentos, Universidade Estadual de Londrina, Londrina, 2011.

FERNANDES RTV, ARRUDA AMV, OLIVEIRA VRM, QUEIROZ JPAF, MELO AS, DIAS FKD, ET AL. **Aditivos fitogênicos na alimentação de frangos de corte: óleos essenciais e especiarias.** Pubvet. 2015;9(12):526-35. doi: 10.22256/pubvet.v9n12.526-535.

FERREIRA, D. F. **Sisvar: a Guide for its Bootstrap procedures in multiple comparisons**. Ciência e Agrotecnologia (UFLA), v. 38, n. 2, p. 109-112, 2014

GAYA, L. DE G.; FERRAZ, J. B. S. Aspectos genético-quantitativos da qualidade da carne em frangos. **Ciência Rural**, v. 36, n. 1, p. 349-356, 2006.

HAMEED IH, ALTAMEME HJ, MOHAMMED GJ. **Evaluation of antifungal and antibacterial activity and analysis of bioactive phytochemical compounds of Cinnamomumzeylanicum(Cinnamon bark) using gas chromatography-mass spectrometry. Orient J Chem**. 2016;32(4):1769-88. doi: 10.13005/ojc/320406.

Harder, M.N.C.; Canniatti-Brazaca, S.G.; Coelho, A.A.D.; Savino, V.J.M.; Franco, C.F.O. 2007.Cholesterol and iron availability in yolk of laying hens feed with annatto (Bixa orellana). **Animal Science 1(1): 477-482.**

Harder, M.N.C.; Spada, F.P.; Savino, V.J.M.; Coelho, A.A.D.; Correr, E.;, Martins, E. 2010. **Coloração de cortes cozidos de frangos alimentados com urucum**. Ciênc. Tecnol. Aliment., 30(2): 507-509.

KARLOVI, S.; JEZEK, D.; BLAZI, M.; et al. Influence of refrigeration and ageing time on textural characteristics of fresh meat. **Croatian Journal of Food Science**, v. 1, n. 2, p. 1-6, 2009.

LE-BIHAN-DUVAL, E., BERRI, C., BAEZA, E., MILLET, C., BEAUMONT, N. Estimation of the genetic parameters of meat characteristics and their genetic correlations with growth and body composition in an experimental broiler line. **Poultry Science**, 80(7):839-843, 2001.

MACARI, M.; LUQUETTI, C. B.; Fisiologia cardiovascular. In: MACARI, M.; FURLAN, R.L.; GONZALES, E.; **Fisiologia aviária aplicada a frangos de corte**. Jaboticabal – SP: FUNEP, 2002. p. 17 - 35.

MOURA, A. M. A.; TAKATA, F. N.; NASCIMENTO, G. R.; SILVA, A. F.; MELO, T. V.; CECON, P. R. Pigmentantes naturais em rações à base de sorgo para codornas japonesas em postura. **Revista Brasileira de Zootecnia.**, v.40, n.11, p.2443-2449,2011.

Parente, I.P.; Albino, L.F.T.; Rodrigues, K.F.; Vaz, R.G.M.V; Sousa, L.F.; Fonseca, F.L.R.; Silva, M.C.; Campos-Alves, C.F.; Noleto, R.A.; 2018. **Cassava bagasse and annatto colorific (*Bixa orellana L.*) in diets for slow-growing broilers from 30 to 90 days of age,** http://dx.doi.org/10.1590/S1519-99402018000100006

PASSOS, P. I. B. **Uso de pigmentantes naturais ou artificiais na qualidade da carne de frangos de corte em diferentes sistemas de criação**. Dissertação de Mestrado, Universidade de Brasília, 2020.

PIZATO, S.. **Avaliação de cor e textura de filés de frango in natura embalados em atmosfera modificada gasosa. In: Embrapa Suínos e Aves-Artigo em anais de congresso** (ALICE). In: Congresso Brasileiro de Ciência e Tecnologia de Carnes, 6., 2011, São Pedro, SP. Anais... São Pedro, SP: ITAL/CTC, p. 1-3, 2011.

PRETE, R. O.; SERAFIM, R. Â.; SOUZA, D. D. F. M.; SAKANAKA, L. S.; YAMAGUCHI, M. M. **Caracterização e aplicação de óleo de orégano como antioxidante natural em linguiça suína frescal**. BrazilianJournalofDevelopment, v. 6, n. 7, p. 44109-44118, 2020.

ROSTAGNO, H. S.; ALBINO, L. F. T.; HANNAS, M. I.; DONZELE, J. L.; SAKOMURA, N. K.; PERAZZO, F. G.; SARAIVA, A.; ABREU, M. L. T.; RODRIGUES, P.B.; OLIVEIRA, B. R.; BARRETO, S. L. T.; BRITO, C.O. **Tabelas brasileiras para aves e suínos: composição de alimentos e exigências nutricionais**. 4. ed. Viçosa, p.349-364, 2017

SELANI, M. M. **Extrato de bagaço de uva como antioxidante natural em carne de frango processada e armazenada sob congelamento**. Dissertação de Mestrado, Universidade de São Paulo, 2010.

SILVA, L.; OLIVEIRA, L. A. A.; REBOUÇAS, L. O. S.; MELO, V. L. L.; OLIVEIRA, P. L. **Avaliação dos parâmetros de cor na carne de frango conservada com erva-sal (*atriplex nummulária*).** II congresso internacional das Ciências Agrárias COINTER- PDVAgro, 2017.

STRINGHETA P. C., SILVA P. I. **Pigmentos de urucum: extração, reações químicas, usos e aplicações**, Viçosa: Suprema, 2008.

ZHAO, X.; CHEN, X.; HAN, M.; et al. Application of isoelectric solubilization/precipitation processing to improve gelation properties of protein isolated from pale, soft, exudative (PSE)- 80 like chicken breast meat. LWT - **Food Science and Technology**, v. 72, p. 141-148, 2016.