MICROBIAL OXYCAROTENOIDS IN BROILER CHICKEN REARING

Elisa H. G. Ponsano[1], Saulo V. Avanço[1], Thiago L. M. Grassi[1], Maria C. S. Minello[1], Edson F. E. Santo[1], Marcos F. Pinto[1] and Manoel Garcia-Neto[1]

[1]Department of Support, Animal Production and Health, Unesp Univ Estadual Paulista, Araçatuba, São Paulo, Brazil

Abstract – This study aimed at evaluating the effects of a bacterial biomass produced in an industrial effluent on broiler chicken pigmentation and performance. A completely randomized experiment was conducted, with four treatments that represented the biomass concentrations in the diets (0, 1.0, 2.0 and 3.0 mg/kg) and five replicates. Performance data were evaluated with 21, 36 and 45 days and the objective color was evaluated on meat and skin of thighs and breast. Yellowness was significantly increased with the increasing concentrations of the biomass on all sites, although chroma remained the same and lightness only changed in breast meat. The biomass at 2.0 mg/kg was the best concentration to provide color enhancement. No differences in the performance of broilers at any age were observed among treatments. So, dietary *R. gelatinosus* biomass produced in fish industry effluent was able to increase yellowness in meat and skin of broilers breast and thigh without causing any detriment to birds' performance.

Key Words – color, performance, *Rubrivivax gelatinosus*.

I. INTRODUCTION

According to Fletcher [1], color is one of the most important quality attribute for poultry meat, being critical for both the consumers' initial selection of the product as well as for final satisfaction. Due to this concern, poultry producers aim to produce products with the appropriate color for a particular market and so they increase the levels of xantophylls (oxycarotenoids) in broilers diets by adding different ingredients for that purpose, that are subsequently deposited in skin and fat [2]. As color preferences vary from country to country, the color of a poultry meat that is attractive to consumers and how to develop it are obviously important factors to be considered by the poultry industry [3]. To Rathgeber *et al*. [4], production and transportation costs of traditional feed ingredients make poultry producers to search for alternative ingredients. Moreover, the knowledge on the involvement of carotenoids in the prevention of some diseases, besides the increasing search of consumers for natural additives over the synthetic ones raised researches with different substances aiming at poultry products pigmentation, such as fish meal [4], plants [2] algae [3], yeasts [5] and bacteria [6, 7].

R. gelatinosus is a phototrophic bacterium that grows in industrial effluents causing the decrease in the organic load of such waters, so representing an additional method for depollution in the industry, and producing a biomass rich in oxycarotenoids and microbial protein [8]. Studies about the utilization of *R. gelatinosus* biomass produced in poultry slaughterhouse wastewater in poultries rearing showed positive effects of the product on the color of yolks and broilers carcasses [6, 9]. Nevertheless, the ability of the biomass produced in fish industry wastewater to increase broilers carcasses color was unknown. So, the aim of this study was to evaluate the effect of dietary *R. gelatinosus* biomass produced in fish industry wastewater on broilers carcasses color and performance**.**

II. MATERIALS AND METHODS

A total of 200 Cobb 500 male broiler chicks 1 d of age were housed in 20 floor pens (1.5 x 3.0 m) and fed commercial corn-soybean meal based diet and water *ad libitum*. The experiment was conducted as a completely randomized design with level of *R. gelatinosus* as the main factor (0, 1.0, 2.0 and 3.0 mg/kg) and five replicates. *R. gelatinosus* biomass was prepared using the fish industry wastewater as the substrate, according to Ponsano *et al*. [10] and contained 57.4% protein and 3.0 mg/g oxycarotenoids. The biomass was incorporated into the base diet during the finishing phase (36 – 45 days). To monitor growth performance, weight gain and feed consumption were recorded at days 21, 36 and 45.

Before slaughter, four broilers of each replicate were subjected to a total feed withdrawal of 12 h. The birds were subsequently slaughtered by cervical dislocation, bled for 3 min, scalded at 55°C for 10 s and plucked by rotating rubber fingers. After evisceration, birds were water-chilled in an ice bath for 60 min to allow the carcass to reach 4 to 5°C at the core.

The color measurements were carried out using a tristimulus colorimeter (Hunter Lab XE plus) standardized against white and black tiles. Objective measurement adopted was CIE *LCh* system (*L* - lightness, *C* – Chroma and *h* – hue). The color values represented the mean of three consecutive pulses measured from the same points on both breast and thigh meat and skin surfaces.

Data on performance and color were analyzed by ANOVA followed by Tukey`s test at 5% significance level.

III. RESULTS AND DISCUSSION

In Table 1, data on color parameters measured on meat and skin of breast and thigh are reported. Hue (*h*) is an angular measure in which 0 represents red and 90 represents yellow and so, values comprised in this interval vary from red to yellow. So, the biomass added into the diets was able to increase yellowness since all *h* values reported were higher than for control groups, which received no biomass (Fig 1). Treatments with 2 mg biomass/kg significantly provided the highest values for *h* (P<0.05), except in thigh meat, in which the higher significant *h* value (P<0.05) was reached with 3 mg biomass/kg. So it is possible to conclude that 2 mg/kg of *R. gelatinosus* biomass produced in fish industry effluent added into a corn based ration is enough to provide an increase in yellowness on meat and skin of breast and thigh.

Color saturation (*C*) did not differ among treatments (P>0.05), while lightness (*L*) tended to an increase with the presence of the biomass, with significant differences (P<0.05) between control group and treatment with 2 mg/kg in breast meat.

In a previous experiment, Ponsano *et al*. [6] also found that the addition of *R. gelatinosus* biomass

Table 1 Color parameters of meat and skin (*L* = lightness; *C* = Chroma; *h* = hue)

	Biomass level (mg/kg)	Mean ± Standard Error [1] *L*	*C*	*h*
Breast meat	0	60.69±0.56[b]	18.74±0.33[a]	68.47±0.64[b]
	1	61.39±0.55[b]	17.78±0.31[a]	69.48±0.58[ab]
	2	63.39±0.43[a]	18.34±0.34[a]	71.19±0.63[a]
	3	62.44±0.44[ab]	18.51±0.30[a]	70.64±0.53[ab]
Thigh meat	0	57.70±0.65[a]	17.36±0.39[a]	58.66±1.10[b]
	1	56.86±0.65[a]	16.73±0.36[a]	60.51±0.93[ab]
	2	57.94±0.62[a]	16.23±0.25[a]	61.07±0.90[ab]
	3	58.87±0.54[a]	16.76±0.29[a]	62.68±0.88[a]
Breast skin	0	68.37±0.43[a]	16.29±0.36[a]	67.93±0.56[b]
	1	69.21±0.35[a]	15.62±0.34[a]	69.48±0.54[ab]
	2	69.88±0.48[a]	16.63±0.45[a]	70.29±0.62[a]
	3	68.76±0.52[a]	16.02±0.36[a]	68.27±0.68[ab]
Thigh skin	0	71.39±0.46[a]	13.62±0.47[a]	69.68±0.86[b]
	1	72.01±0.44[a]	13.23±0.39[a]	71.47±0.78[ab]
	2	72.82±0.52[a]	13.11±0.47[a]	73.16±0.94[a]
	3	72.20±0.42[a]	12.44±0.38[a]	69.90±0.83[b]

[1] Numbers followed by different letters in the column differ significantly (P<0,05)

produced in poultry slaughterhouse wastewater into a sorghum base diet tended to provide an increase in yellowness and *C* values of meat, but with no change on *L*. In another experiment, also using *R. gelatinosus* biomass produced in poultry slaughterhouse wastewater into a sorghum base diet, Ponsano *et al*. [7] found a significant increase in yellowness of breast skin, with no changes for *L* and *C*. These findings indicate that many factors can play a role in determining the final skin and meat color of broilers, such as the type and the concentration of the pigment, among others.

Figure 1 - Carcasses from control group and treatments

Data on performance are reported in Tables 2, 3 and 4. Ponsano *et al*. [7], using *R. gelatinosus* biomass produced in poultry slaughterhouse wastewater as the pigmenting agent into a sorghum base diet, found no effects of treatments on feed intake, while the highest *R.*

gelatinosus biomass supplementation level tested (300 ppm) and control group showed the best weight gain and feed conversion. At the present study, using *R. gelatinosus* biomass produced in fish industry effluent, none of the performance recorders differed significantly among treatments. This may be considered an important finding since it indicates that the product was not detrimental to broiler chicken production.

Table 2 Feed consumption of broilers at 21, 36 and 45 days (g)

Biomass level (mg/kg)	Mean ± Standard Error [1]		
	21 days	36 days	45 days
0	1.33 ± 0.01[a]	3.72 ± 0.06[a]	5.85 ± 0.13[a]
1	1.31 ± 0.01[a]	3.78 ± 0.04[a]	5.94 ± 0.09[a]
2	1.32 ± 0.03[a]	3.76 ± 0.08[a]	5.91 ± 0.10[a]
3	1.30 ± 0.01[a]	3.72 ± 0.03[a]	5.89 ± 0.03[a]

[1] Numbers followed by the same letter in the column do not differ significantly (P>0,05)

Table 3 Feed conversion of broilers at 21, 36 and 45 days

Biomass level (mg/kg)	Mean ± Standard Error [1]		
	21 days	36 days	45 days
0	1.32 ± 0.01[a]	1.53 ± 0.01[a]	1.637 ± 0.02[a]
1	1.32 ± 0.01[a]	1.51 ± 0.03[a]	1.647 ± 0.01[a]
2	1.33 ± 0.02[a]	1.52 ± 0.04[a]	1.642 ± 0.01[a]
3	1.29 ± 0.01[a]	1.47 ± 0.01[a]	1.592 ± 0.02[a]

[1] Numbers followed by the same letter in the column do not differ significantly (P>0,05)

Table 4 Weight gain of broilers with 21, 36 and 45 days (g)

Biomass level (mg/kg)	Mean ± Standard Error [1]		
	1 - 21 days	1 - 36 days	1 - 45 days
0	0.96 ± 0.01[a]	2.41 ± 0.05[a]	3.60 ± 0.05[a]
1	0.95 ± 0.02[a]	2.48 ± 0.07[a]	3.53 ± 0.06[a]
2	0.95 ± 0.02[a]	2.47 ± 0.06[a]	3.56 ± 0.03[a]
3	0.96 ± 0.01[a]	2.54 ± 0.07[a]	3.60 ± 0.05[a]

[1] Numbers followed by the same letter in the column do not differ significantly (P>0,05)

IV. CONCLUSION

Dietary *R. gelatinosus* biomass produced in fish industry effluent was able to increase yellowness in meat and skin of broilers breast and thigh and caused no detriment to birds` performance. These results point to the potential use of the product as a pigmenting agent for broilers ration.

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