RHODOCYCLUS GELATINOSUS BIOMASS FOR BROILER CHICKEN PIGMENTATION

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Background

Color is considered an especially important quality attribute of foods. Consumers generally associate the good color of a food item to its good quality, since it refers to sanity, freshness, good taste and good nutritional value. Because of this association, natural colorants have historically been added to the foods and beverages to improve product attractiveness and quality. In certain regions of Brazil, consumers prefer poultry products that show intense pigmentation. In order to meet this demand, poultry producers generally add natural or synthetic colorants to broiler feeds. These colorants must be oxycarotenoids (xanthophylls), a group of carotenoids that provide pigmentation due to selective deposition on different animal tissues (Marusich & Bauernfeind, 1981; Klaui & Bauernfeind, 1981; Latscha, 1990; Hencken, 1992; Franchini & Padoa, 1996; Liufa et al., 1997). The synthetic pigment apocarotenoic acid ethyl ester (APO-EE), despite its high cost, is the most widely used for this purpose, although new oxycarotenoids have been isolated from algae and special microorganisms. These oxycarotenoids may find use in a purified form or as a biomass. More than a pigmenting potential, the microbial biomass contains proteins, minerals and vitamins that may be beneficent to animals if it is added to the feed (Balloni et al., 1982). Recent works accomplished with *Rhodocyclus gelatinosus* biomass produced in an industrial wastewater revealed the positive effect of the product on broiler pigmentation (Ponsano, 2000; Ponsano et al., 2002). Moreover, the biomass producing process caused a decrease in pollutant load of the waste. These preliminary results indicate this biomass as a feasible alternative for pigment production.

Objectives

This research investigated the pigmenting potencial of APO-EE and *Rhodocyclus gelatinosus* biomass added to a free-oxycarotenoid broiler feed as colorants.

Methods

Two hundred sixteen Cobb one-day-old male broiler chicks were raised in 1.5 x 3.0 m pens equipped with identical feeders and drinkers to provide rations and water on an *ad libitum* basis. From day 1 to day 7, chicks standed together in one pen, where they received starter ration (Table 1) and light heating full time. From day 8 to day 21, birds were allocated in two pens and received starter ration and light heating during the night. From day 22 to day 28, birds were distributed in four pens and, from day 29 to 35, they were distributed in 36 pens (6 birds per pen). During this period, broilers were fed grower ration (Table 1). From day 36 to 40, broilers were fed the experimental rations that consisted of different levels of APO-EE and *Rhodocyclus gelatinosus* biomass added to the finisher basal ration (Tables 1, 2). Four pens were assigned to each of the nine treatments. All rations followed NRC (1994) recommendations and were prepared with sorghum, free of oxycarotenoids, in order to better show pigmentation results. The lyophilized *Rhodocyclus gelatinosus* biomass containing oxycarotenoids from the alternative spirilloxanthin series was produced on poultry slaughterhouse wastewater as described by Ponsano (2000). At the end of the experiment, twelve broilers from each treatment were randomly selected for slaughtering and evisceration according to Brazilian laws (Brasil, 1997). Carcasses were packaged within plastic films and held at 0^oC ($\pm 1^oC$) until the moment of color determination. For the color analysis, broilers were washed and breast and thigh skin were kindly raised up. Birds were covered with a dry film for the color analysis procedure, that was performed with a Hunter Lab model Color Quest II colorimeter. Lightness, chroma and hue mean values were measured on breast and thigh skin and meat (CIE, 1986). Data were analyzed by ANOVA and means were compared by Duncan Test, according to Snedecor & Cochran (1967).

Results and discussion

Breast and thigh skins of control group were lighter than the others. Treatment E provided the darkest colors on breast and thigh skins. Ligthness of the groups that received *R. gelatinosus* biomass did not differ significantly from control group on breast skin but they did on thigh skin. At this site, treatments with biomass provided darker colors. Concerning to hue, treatments F, G and I differed from control group on breast skin, providing yellowish colors. Treatments with APO-EE did not differ from control group at this site, providing reddish hues. No significant differences were found for hue among treatments on thigh skin. In general, color saturation (croma) increased according to the increase of both pigments, such on breast as on thigh skin. Nevertheless, croma values were less intense in the treatments with both pigments. On breast and thigh meat, control treatments also showed the lightest colors. The darkest color found on breast meat was provided by treatment I, that contained the highest amount of *R. gelatinosus* biomass. This treatment well as treatment B, with APO-EE, also provided the darkest colors on thigh meat. All treatments showed equivalent hues such on breast as on thigh meat (exception to treatment F on breast meat). Once again, the increase on pigments amounts led to increases on color saturation (croma) in all cases.

Conclusions

Oxycarotenoids of *R. gelatinosus* biomass, at the amounts used in this research, were effective to promote broiler pigmentation. In a general sense, this product showed similar results, both on breast as on thigh skin and meat. *R. gelatinosus* biomass provides darker colors than the control group, tends to provide yellowish hues and increases croma values, according to its increase in the ration.

Pertinent Literature

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Table 1. Ration compositions

INGREDIENT	STARTER (1 – 21 days)	INGREDIENT	GROWER (22 – 35 days)	FINISHER (basal) (36 - 40 days)
Sorghum	59.32	Sorghum	50.92	53.94
Soybean meal	33.00	Whole soybean	44.80	40.95
Soybean oil	3.90-	Dicalcium phosphate	2.00	1.55
Dicalcium phosphate	1.65	Limestone	1.15	1.45
Limestone	1.20	NaCl	0.40	1.25
NaCl	0.267	Soybean oil	0.20	0.40
DL methionine	0.235	DL methionine	0.076	0.05
Choline 75%	0.0205	Yeast	0.05	0.0065
Vitamin mineral premix	0.30	Vitamin mineral premix	0.40	0.40

Table 2. Pigment supplementation for basal ration

PIGMENT SOURCE (ppm)	TREATMENT A	B	C	D	E	F	G	H	I
APO-EE	0	10	20	30	40	0	0	0	0
R. gelatinosus biomass	0	0	0	0	0	37	75	150	300

Table 3. Color attributes for breast and thigh skin

TREATMENT	BREAST SKIN			THIGH SKIN		
	L ($\bar{x} \pm s$)	C ($\bar{x} \pm s$)	h ($\bar{x} \pm s$)	L ($\bar{x} \pm s$)	C ($\bar{x} \pm s$)	h ($\bar{x} \pm s$)
A (control)	73.93 ± 1.52^{a}	14.56 ± 0.87^{a}	76.45 ± 1.63^{c}	75.68 ± 0.96^{a}	10.20 ± 1.67^{a}	76.03 ± 2.74^{a}
B	71.37 ± 0.85^{bc}	13.45 ± 2.10^{a}	78.64 ± 3.62^{abc}	72.66 ± 1.82^{b}	5.77 ± 1.06^{d}	74.38 ± 4.49^{a}
C	72.35 ± 1.57^{abc}	13.20 ± 1.80^{a}	79.03 ± 2.17^{abc}	73.77 ± 0.60^{ab}	6.43 ± 1.46^{cd}	75.81 ± 3.65^{a}
D	71.69 ± 0.72^{abc}	15.12 ± 1.81^{a}	79.72 ± 1.71^{abc}	73.77 ± 1.26^{ab}	8.92 ± 1.49^{ab}	77.53 ± 3.06^{a}
E	70.61 ± 0.51^{c}	15.93 ± 1.26^{a}	79.44 ± 0.92^{abc}	71.47 ± 1.10^{b}	10.12 ± 1.25^{a}	75.14 ± 4.18^{a}
F	73.63 ± 1.96^{ab}	9.99 ± 2.93^{b}	81.91 ± 1.09^{a}	73.01 ± 2.65^{b}	6.75 ± 0.48^{cd}	78.63 ± 2.09^{a}
G	72.70 ± 1.87^{abc}	14.04 ± 0.50^{a}	80.14 ± 1.75^{ab}	72.77 ± 1.58^{b}	7.55 ± 0.87^{bcd}	76.09 ± 3.99^{a}
H	72.35 ± 1.69^{abc}	14.55 ± 2.85^{a}	77.55 ± 1.15^{bc}	73.12 ± 1.40^{b}	8.10 ± 1.03^{bc}	76.53 ± 3.62^{a}
I	72.23 ± 1.09^{abc}	14.29 ± 1.15^{a}	81.60 ± 2.63^{a}	72.95 ± 1.45^{b}	10.53 ± 1.86^{a}	79.13 ± 1.79^{a}

Means in a column with different superscripts differ significantly ($P < 0.05$)

Table 4. Color attributes for breast and thigh meat

TREATMENT	BREAST MEAT			THIGH MEAT		
	L ($\bar{x} \pm s$)	C ($\bar{x} \pm s$)	h ($\bar{x} \pm s$)	L ($\bar{x} \pm s$)	C ($\bar{x} \pm s$)	h ($\bar{x} \pm s$)
A	60.56 ± 0.71^{a}	11.25 ± 1.07^{de}	68.52 ± 1.90^{b}	63.83 ± 0.24^{a}	9.98 ± 0.60^{d}	64.62 ± 3.39^{a}
B	58.96 ± 0.58^{ab}	9.72 ± 0.42^{e}	71.89 ± 1.28^{ab}	59.93 ± 1.39^{d}	10.07 ± 0.78^{d}	64.39 ± 2.30^{a}
C	57.60 ± 1.89^{bc}	11.70 ± 1.77^{d}	69.05 ± 2.48^{b}	61.07 ± 1.05^{bcd}	10.27 ± 1.41^{d}	63.70 ± 3.55^{a}
D	57.63 ± 1.35^{bc}	15.42 ± 1.68^{ab}	72.09 ± 1.53^{ab}	61.32 ± 1.00^{bcd}	12.73 ± 0.72^{a}	65.49 ± 1.96^{a}
E	58.38 ± 0.93^{bc}	16.08 ± 0.43^{a}	70.69 ± 0.49^{ab}	60.11 ± 1.08^{cd}	12.47 ± 1.77^{ab}	63.70 ± 2.03^{a}
F	58.07 ± 0.35^{bc}	9.88 ± 1.17^{e}	73.67 ± 1.38^{a}	60.47 ± 1.33^{cd}	9.85 ± 0.65^{d}	63.39 ± 4.07^{a}
G	59.64 ± 0.95^{ab}	13.61 ± 1.05^{c}	71.06 ± 2.59^{ab}	62.57 ± 1.42^{ab}	10.83 ± 1.00^{cd}	64.73 ± 4.61^{a}
H	58.62 ± 2.20^{abc}	14.06 ± 0.50^{bc}	70.70 ± 3.98^{ab}	61.78 ± 1.08^{bc}	11.04 ± 0.74^{bcd}	65.44 ± 2.14^{a}
I	56.72 ± 1.16^{c}	14.52 ± 1.12^{abc}	70.34 ± 2.50^{ab}	59.96 ± 0.27^{d}	12.09 ± 0.25^{abc}	63.51 ± 2.17^{a}

Means in a column with different superscripts differ significantly ($P < 0.05$)