

Effects of canthaxanthin supplementation in the ROSS breeder diet on oxidative stress of chicks.

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A field trial was run with the objective to determine the effect of 6 ppm canthaxanthin in ROSS breeders feed (through supplementation with 60 ppm CAROPHYLL® Red) on the anti-oxidant status of their progeny. The 1 day chicks have very variable antioxidant status and could partly explain differences on their performances. The canthaxanthin is a carotenoid studied for its antioxidant activity. Two experimental batches (2 X 9000 breeders) on the same site of breeding of a hatchery were integrated into the test. The experimental ROSS PM3 Yellow breeders received the canthaxanthin during 12 weeks, from 27 to 38 weeks of age. The feed was heat treated, wheat, corn and soya meal based. Blood samples were taken from 75 chicks resulting from breeders from each batch.

The antioxidant status of sera of 1-day chicks were significantly higher and the TBARS level significantly lower with 6 ppm canthaxanthin in the breeder feed. These results indicated that maternal supplementation with canthaxanthin (6ppm) enhances antioxidant capability and depresses oxidative stress in chicks.

Keywords : broiler, breeder, 1 day-chick, canthaxanthin, anti-oxidative status, tbars

Introduction

The supply of adequate levels of nutrients in the maternal diet is critical in ensuring that sufficient are available for embryonic development and subsequent emergence of a healthy viable hatchling. The sensitivity of one day chicks to oxidative stress is greatly depending on the maternal diet (Lin 2005, Surai 1999, Karadas 2005). These differences in anti-oxidative status of one day chicks, induced by maternal diet, could explain differences in health performances (Koutsos 2006, Karadas 2005, Blunt 2000). The ability to manipulate the antioxidant system of the developing chick, through the maternal diet, would offered poultry producers an opportunity to improve chicks health during the first weeks of life.

The transfer of antioxidant status towards chick is done primarily via lipidic antioxidants (vitamin E, vitamin A, fatty acids, carotenoids) and minerals. Canthaxanthin has been shown to have good free radical-trapping properties at low partial pressures of oxygen, such as those that pertain in healthy tissues (Frankel, 1989). A dietary supplementation of the breeder diet with canthaxanthin is associated with a proportional accumulation of this carotenoid in the egg yolk and this is associated with a change in yolk colors from pale yellow through to deep orange as the concentration increased. Canthaxanthin is routinely fed at a wide range of dietary levels to provide pigmentation for animal products. According to Surai and coll, 2003, the accumulation of canthaxanthin in the tissues of both the embryonic and post-hatch chick occurred in proportion to its concentration in the yolk. It was notable that although the canthaxanthin that had accumulated in the various tissues was utilized over time even at 7 days post hatch elevated levels of carotenoid were detectable in the liver and plasma of chicks hatched from carotenoid enriched eggs.

These data highlight the importance of the maternal diet on the composition of the embryo and day-old chick but also highlight the potentially relatively long-term impact of such changes.

The purpose of this study was to determine the impact of canthaxanthin in the breeder diet on the chick antioxidant status.

Materials and methods

Birds, feeding and housing

The trial was conducted in 2 experimental buildings on the same site of breeding of a hatchery located in Brittany -France. The building test (building 1) gives generally lower results than the control building (building 2).

Table 1 Experimental design

	Number	Batch	Product	Dosage
Building 1	9000	A	Canthaxanthin*	6 ppm
Building 2	9000	B	-	-

* Carophyll® Red (DSM Nutritional Products)

Broiler breeders sourced from the same parent flock ROSS PM3 Yellow. The feed was heat treated. It was mainly composed of wheat, corn and soya. Canthaxanthin was distributed from 27 to 38 weeks of age.

Breeder performances

Laying rate, breeder mortality, number eggs/ breeder, number incubated eggs/ breeder, number chicks/ breeder, hatching rate were recorded at 38 and 41 weeks of age

Sampling of chicks

75 chicks from 30 weeks old breeders from each building were sent to DELTAVIT laboratory. Breeders from building 1 had received canthaxanthin during 4 weeks. The chicks were submitted to 150 km road transport from the hatchery to the laboratory which is a similar stress to the common transfer from the hatchery to a farm. No feed was available to the chicks. Therefore, the blood was quickly sampled to keep on the stressful conditions. Blood is obtained by bleeding, is centrifuged immediately after retraction of the clot and preserved at -70°C before analysis. They were mixed from 3 chicks samples in order to have a sufficient quantity of serum to carry out the analyses.

Analysis

Serum malondialdehyde (MDA) concentrations were evaluated by the TBARS technique (Satoh 1978). MDA is a breakdown product of the cellular membrane lipids by the free radicals. The antioxidant status of chicks sera was evaluated using the TAS Randox kit. This test evaluates the in vitro capacity of serum to scavenge free radicals. The analyses were carried out at DELTAVIT laboratory

Colour measurements

The colour of chickens was measured with a Chromameter CR-300 Minolta calibrated and standardised according to the space color Hunter (CO11976): luminosity (L *), red (a *) and yellow (b *) and with illuminating standard C average Daylight (not including the zone of the ultraviolet rays).

Statistical analysis

The zootechnical data are recorded on a purely informative basis. The other data are analyzed using the univariate GLM procedure of SPSS 14.00.

Results

Breeder performances

Productions data are shown in *table 2*. The production of eggs was higher within the canthaxanthin supplemented breeders (*figure 1*). Therefore the number of chicks was higher in this group.

Figure 1 Laying rate curve

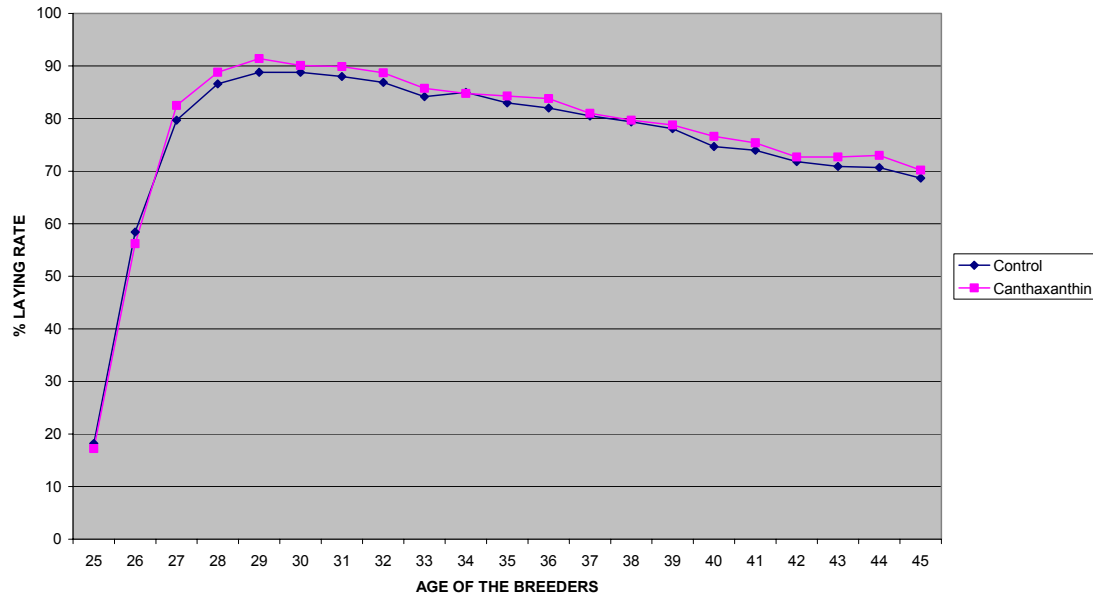


Table 2 Productions data

At 38 weeks (end canthaxanthin suppl)	Control	Canthaxanthin	% Control
Breeder mortality (%)	1,11	1,27	114
Number eggs/ breeder	73,42	76,65	104
Number incubated eggs/ breeder	66,82	71,31	107
Number chicks/ breeder	57,93	58,22	101
Hatching rate (%)	86,06	85,16	99
At 41 weeks	Control	Canthaxanthin	Essai
Breeder mortality (%)	1,4	1,58	113
Number eggs/ breeder	89,08	92,58	104
Number incubated eggs/ breeder	82,23	87,08	106
Number chicks/ breeder	70,71	74,2	105
Hatching rate (%)	85,99	85,21	99

Chicks results

The chicks average weights were the same in both groups. The a value was identical whereas the b yellow and the luminosity were lower with the canthaxanthin group. The chicks antioxidant status was higher and the TBARS lower in the canthaxanthin group (*table3*).

Discussion - conclusion

Canthaxanthin as a red pigment is used to influence the red a value measured with the colorimeter. The canthaxanthin supplementation failed to improve the red color of the chicks shanks. This result is not in agreement with previous study where Shank color at birth using the Roche fan showed an increase of

pigmentation with canthaxanthin (Llaurado, 1997). We hypothesized that this transfer of canthaxanthin to shanks may depend on the breed. The most important finding of this study was a positive effect of canthaxanthin on the antioxidant status of the day-old chicks. This is consistent with previous study supporting the hypothesis that dietary canthaxanthin can modulate antioxidant systems in the developing chick (Surai, 2003). This better antioxidative status decreases the detrimental effect of oxidative stress as shown by the TBARS results. These results indicated that maternal supplementation with canthaxanthin at 6ppm enhances antioxidant capability and depresses oxidative stress in chicks.

Table 3 One day chicks measurements

	Control	Canthaxanthin	ANOVA	% control
n	75	75		
Chick weight (g)	37,04	37,25	NS	-
Colorimeter measurements				
a red	5,6	5,5	NS	-
b yellow	19,87	17,78	P<0,01	89
L Luminosity	59,88	55,82	P<0,01	93
Antioxidant status				
TBARS (µmol/l)	2,23	1,96	P<0.01	88
Total Antioxidant Statut Randox (mMol Eq TROLOX/l)	0,56	0,89	P<0.01	159

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