Comparative use of pigments in feed or drinking water for laying hens under stress conditions

A.M. PÉREZ-VENDRELL[1*] and J. M. HERNANDEZ[2]

[1] Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Centro de Mas Bové, Apartado de Correos 415, 43280 Reus, España.
[2] DSM Nutritional Products Ltd., Bldg. 241/838 Wurmisweg 576, 4303 Kaiseraugst, Switzerland.
***Corresponding author: anna.perez@irta.es**

The objective of this trial was to evaluate the use of pigmenting products in water compared to inclusion in feed on performance of laying hens and egg yolk colour, when birds were subjected to feed restriction simulating practical stress conditions where feed intake or nutrient absorption is impaired. The experiment covered 8 weeks of the laying period. 120 Hy-Line brown hens were allocated into 24 replicates. Two basal wheat-barley diets were used, for different periods: diet A: without pigments, diet B: diet A + 60 ppm Carophyll Yellow (CY) 10% + 60 ppm Carophyll Red (CR) 10%. There were 3 experimental treatments replicated 8 times: 1) diet A for 2 weeks, followed by diet B for 6 weeks; 2) Same as 1 except that feed was restricted during weeks 5 and 6 to 70 % of normal intake; 3) Same as 2, except that 10 mg of CY 10 % and 10 mg CR 10 % /L of drinking water were provided during week 6. Performance parameters were evaluated for 2-week periods. Feed and water intake of hens were recorded during the stress period. Egg weight, albumen height, Haugh units and egg yolk colour, measured by means of DSM Yolk Colour Fan (previously called Roche Yolk Colour Fan) were evaluated weekly in no stress periods and every two days during stress. In the first 4 weeks of experiment, no statistical differences were found between treatments in any of parameters evaluated, but egg yolk colour was low (DSM fan values about 2,7) in weeks 1 and 2, and colour increased quickly to DSM fan values of around 14. in week 4. In week 5, stress reduced all productive parameters evaluated, and no differences were found between T-2 and T-3. The same pattern was observed in characteristics of eggs, and yolk colour of eggs from T-2 and T-3 were significantly lower than yolk colour of T-1 (P<0.0001). In week 6, the addition of pigments to water of hens from T-3 increased yolk colour, reaching the same values of eggs from T-1. At the end of the trial no differences between treatments were observed. These results suggest that CR10% and CY10% products included in water could minimise problems of egg pigmentation observed under stress conditions without blocking up the water lines in the farm as revealed by daily observation.

Keywords: carotenoids; feed; water; stress conditions; egg yolk colour.

Introduction

Yolk pigmentation is an important factor in consumer acceptance and perceived quality of eggs. The color of egg yolk is provided by carotenoid pigments present in the diet of hens. The amounts and availability of carotenids in poultry feed ingredients fluctuate considerably (Pérez-Vendrell et al, 2001). It has therefore become common practice in poultry industry to add carotenoids to the feed to assure the necessary amount for pigmentation. In some cases, layers reduce their feed intake due to different causes as heat stress, sub clinical diseases, especially intestinal infections and parasitic infestations (Tyczkowski et al, 1991), which in turn produces a decrease in egg yolk colour. In order

to avoid this problem, pigmenting products which could be administered to the layers in water have been developed.

The objective of this trial was to evaluate the use of pigmenting products in water compared to inclusion in feed on performance of laying hens and egg yolk colour, when birds were subjected to feed restriction simulating practical stress conditions where feed intake or nutrient absorption is impaired.

Material and methods

The experiment covered 8 weeks of the laying period: 2 weeks of depletion period and 6 weeks of experimental pigmentation period. 120 Hy-Line brown hens 51-week old were allocated into 24 replicates. Two basal wheat-barley diets were used, for different periods: diet A: without pigments, diet B: diet A + 60 ppm Carophyll Yellow (CY) 10% + 60 ppm Carophyll Red (CR) 10%. The composition of this low carotenoid diet is shown in Table 1. Feed and water were provided for *ad libitum* consumption throughout the experiment and diets were presented in mash

There were 3 experimental treatments replicated 8 times. The arrangement of treatments is presented in Table 2. Stress was obtained by a reduction of feed intake (around 30%).

Table 1: Composition of basal experimental diet

Ingredients	**(%)**
Barley	30.82
Wheat	28.91
Sunflower meal 36 CP	7.00
Soybean meal, 47 CP	14.00
Full fat extruded soybeans	6.00
Lard	2.60
Vitamins and minerals	10.67
AME, kcal/kg*	2550
Crude protein, %	18.59
Ether extract, %	5.18
Ash, %	12.77
Crude fibre, %	3.97
Lys, %	0.83
Met, %	0.46
Met+Cys, %	0.78
Ca, %	3.59
P, %	0.65
NPP, %	0.42

Table 2: Description of experimental treatments

Treatment	Weeks of experiment							
	1	2	3	4	5	6	7	8
T-1	Diet A, no stress		Diet B, no stress		Diet B, no stress	Diet B, no stress	Diet B, no stress	
T-2	Diet A, no stress		Diet B, no stress		Diet B, with stress	Diet B, with stress	Diet B, no stress	
T-3	Diet A, no stress		Diet B, no stress		Diet B, with stress	Diet B, with stress + (10 mg CY 10% + 10 mg CR 10%/l water)	Diet B, no stress	

. Performance parameters (egg laying rate (%) and egg mass production and feed conversion efficiency (feed intake/egg mass) were evaluated for 2-week periods. Feed and water intake of hens were recorded during the stress period. Egg weight, albumen height, Haugh units and egg yolk colour, measured by means of DSM Yolk Colour Fan (previously called Roche Yolk Colour Fan) were evaluated weekly in no stress periods and every two days during stress.

Results and discussion

In the first 4 weeks of experiment, no statistical differences were found between treatments in any of parameters evaluated (Table 3), but egg yolk colour was low (DSM fan values about 2,7) in weeks 1 and 2, and colour increased quickly to DSM fan values of around 14 in week 4 (Table 5).

Table 3: Productive parameters obtained in first 4 weeks of trial (no stress period).

Treatment	Weeks 1 and 2: diet A			Weeks 3 and 4: diet B		
	Rate of lay (%)	**Feed efficiency (feed /egg mass)**	**Egg weight (g)**	**Rate of lay (%)**	**Feed efficiency (feed /egg mass)**	**Egg weight (g)**
T-1	79.1	1.94	65.0	90.2	1.86	66.5
T-2	79.5	1.93	63.2	83.8	1.97	64.3
T-3	79.6	2.05	63.8	84.1	1.98	65.1
St.Err.	*3.57*	*0.10*	*0.64*	2.47	0.05	0.68
P>F	*0.93*	*0.66*	*0.16*	*0.37*	*0.19*	*0.09*

In weeks 5 and 6, hens of treatments T-2 and T-3 were submitted to stress produced by a restriction of around 30% of feed provided. The feed restriction produced a statistical significant decrease in rate of lay ($P<0.05$) and in egg weight ($P<0.0001$) in relation to treatment T-1. No statistical significant differences were found between performance of hens from T-2 and T-3 treatments, showing no effect of addition of pigments in drinking water on any of the productive parameters evaluated (Table 4).

Table 4: Productive parameters obtained in last 4 weeks of trial.

Treatment	Weeks 5 and 6: Stress period			Weeks 7 and 8: No stress period		
	Rate of lay (%)	**Feed efficiency (feed /egg mass)**	**Egg weight (g)**	**Rate of lay (%)**	**Feed efficiency (feed /egg mass)**	**Egg weight (g)**
T-1	81.1 a	2.30 a	66.3 a	86.2	1.99 b	66.1 a
T-2	71.1 b	1.66 b	61.3 b	81.2	2.39 a	63.1 b
T-3	71.8 b	1.67 b	61.6 b	76.6	2.55 a	64.1 ab
St.Err.	3.04	0.08	0.70	3.23	0.10	0.69
P>F	***0.04***	***0.0001***	***0.0001***	*0.13*	***0.002***	***0.02***

In week 5, the same pattern was observed in characteristics of eggs, and yolk colour of eggs from T-2 and T-3 were significantly lower than yolk colour of T-1 ($P<0.0001$) (Table 5). In week 6, the addition of pigments to water of hens from T-3 increased yolk colour, reaching the same values of eggs from T-1

After 2 weeks on stress, in weeks 7 and 8, experimental feeds *ad libitum* were provided to all hens. A increase on daily egg mass and on rate of lay of hens from treatments T-2 and T-3 were observed, reaching almost the same levels of treatment T-1, and no statistical differences between treatments were obtained for these parameters. Nevertheless, layers of treatments T-2 and T-3, previously

stressed, showed a feed intake significant higher than layers of treatment T-1 (not stressed) (P<0.0001), which in turn impaired feed efficiency. Egg weight values from T-2 and T-3 treatments increased in relation to data obtained in previous stress period, but were lower than those of hens from T-1 treatment.(Table 4). At the end of the trial no differences between treatments in egg yolk colour were observed (Table 5).

Table 5: Evolution of yolk colour of eggs along the experiment.

Treatment	DSM Colour Fan Values							
	Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**
T-1	2.77	2.64	14.3	14.3	14.4 a	14.2 a	14.1 b	14.0
T-2	2.70	2.66	14.2	14.4	13.4 b	13.6 b	14.4 ab	14.1
T-3	2.62	2.61	14.2	14.4	13.7 b	14.2 a	14.5 a	14.2
St.Err.	0.11	*0.09*	0.12	0.11	0.14	0.14	0.12	0.16
P>F	*0.64*	*0.94*	*0.86*	*0.58*	***0.0001***	***0.001***	***0.05***	*0.70*

These results suggest that CR10% and CY10% products included in water could minimise problems of egg pigmentation observed under stress conditions without blocking up the water lines in the farm as revealed by daily observation

References

PÉREZ-VENDRELL, AM.; HERNÁNDEZ, J.M.; LLAURADÓ, L.; SHIERLE, J. and BRUFAU, J. (2001). Influence of source and ratio of xanthophylls pigments on broiler chicken pigmentation and performance. *Poultry Sci.* **80:** 320-326.

TYCZKOWSKI, J.; SCHAEFFER, J.L. and HAMILTON, P.B. (1991). Measurement of malabsorption of carotenoids in chickens with pale-bird syndrome. *Poultry Sci*. **70**: 2275-2279.