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**The welfare through nutrition: carotenoids in quail eggs.**Stefano P. Marelli<sup>1</sup>, Susanna E.M. Lolli<sup>1</sup>, Peter F. Surai<sup>2</sup> and Valentina Ferrante<sup>1</sup><sup>1</sup>Università degli Studi di Milano, Department of Veterinary Science and Public Health, Milan, Italy<sup>2</sup>Feed-Food.Ltd and Scottish Agricultural College, Ayr, Scotland, UK

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Carotenoids are organic pigments synthesized by plants, algae and fungi characterised by antioxidant properties. Animals are unable to synthesize them so they must be acquired from food. The important action of carotenoids on animal welfare is related to their antioxidant and immunomodulatory activity and they are powerful free radical scavengers and they play a basic role in embryonic and early post hatching development contrasting the high oxidative stress; furthermore they influence the nestling phenotype. In wild birds many studies have been performed on the importance of carotenoids both during and out of reproductive period all of them leading to define carotenoids as a limiting resource. The aim of the present study was to evaluate the effect of carotenoids extracted from *Tagetes erecta* on quail eggs characteristics. Twentyfour 24 birds (*Coturnix coturnix japonica*) were reared in 4 different 4 m<sup>2</sup> litter floor family (1 M/5 F) pens, 2 experimental group (Control and Treatment) with 2 replicates per group were organised. The treatment group diet contained a supplementation of yellow xanthophylls (1.67g/kg). Collected eggs were singly weighed and yolk was separated, yolk colour was graded according to yolk colour fan DSM® , Roche®, total carotenoids were extracted and their concentration measured with a spectrophotometer (446nm). Statistical analyses were performed by the analysis of variance using the GLM procedure of SAS ® statistics package (2009). Student's t-test was applied to the calculations of the least square means difference. No differences in birds performances were recorded; on the contrary yolk colour differences and total carotenoids concentrations were highly significant: natural pigments from marigold clearly turn to strong yellow yolk colour and produce ten folds higher concentrations of total carotenoids in T eggs. Carotenoids supplementation in maternal diets could be considered an effective way to supply powerful antioxidant substances to contrast hatching and developmental oxidative stress improving birds adaptability and welfare.

Keywords: oxidative stress, carotenoids, maternal diet, hatching



# The welfare through nutrition: carotenoids in quail eggs

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## Introduction

Carotenoids are organic pigments synthesized by plants, algae and fungi characterised by antioxidant properties. Animals are unable to synthesize them so they must be acquired from food. The important action of carotenoids on animal welfare is related to their antioxidant and immunomodulatory activity and they are powerful free radical scavengers and they play a basic role in embryonic and early post hatching development contrasting the high oxidative stress; furthermore they influence the nestling phenotype. In wild birds many studies have been performed on the importance of carotenoids both during and out of reproductive period all of them leading to define carotenoids as a limiting resource.

## Aim

The aim of the present study was to evaluate the effect of carotenoids extracted from *Tagetes erecta* on quail eggs characteristics.

## Materials & Methods

Twentyfour 24 birds (*Coturnix coturnix japonica*) were reared in 4 different 4 m<sup>2</sup> litter floor family (1 M/5 F) pens, 2 experimental group (Control and Treatment) with 2 replicates per group were organised. The treatment group diet contained a supplementation of yellow xanthophylls (1.67g/kg). Collected eggs were singly weighed and yolk was separated, yolk colour was graded according to yolk colour fan DSM<sup>®</sup>, Roche<sup>®</sup>, total carotenoids were extracted and their concentration measured with a spectrophotometer (446nm). Statistical analyses were performed by the analysis of variance using the GLM procedure of SAS<sup>®</sup> statistics package (2009). Student's t-test was applied to the calculations of the least square means difference.

## Results and discussion

No differences in birds performances were recorded; on the contrary yolk colour differences and total carotenoids concentrations were highly significant: natural pigments from marigold clearly turn to strong yellow yolk colour and produce ten folds higher concentrations of total carotenoids in T eggs..

## Conclusions

Carotenoids supplementation in maternal diets could be considered an effective way to supply powerful antioxidant substances to contrast hatching and developmental oxidative stress improving birds adaptability and welfare.



Fig 1: *Coturnix coturnix japonica* adult hen



Fig. 2: *Tagetes erecta* flower



Fig. 3: *Coturnix coturnix japonica* and *Gallus gallus domesticus* 1 day old chick



Fig. 4: quail egg and egg yolk



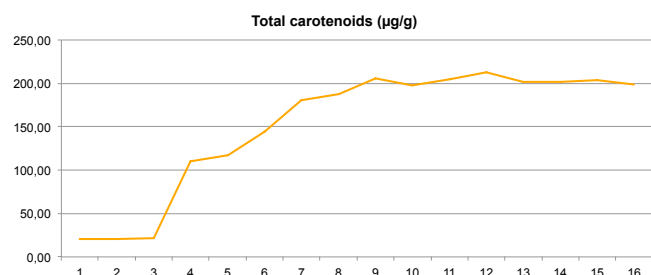
Fig. 4: Yolk colour fan DSM<sup>®</sup>, Roche<sup>®</sup>



Fig. 4: Spectrophotometer

	treatments	
	Control	Treatment
Egg weight	12.97±41.71	12.87±41.71
Yolk weight	3.98±0.15	3.82±0.15
Yolk colour	4.00±0.00 <sup>B</sup>	13.00±0.00 <sup>A</sup>
Total carotenoids	23.33±3.50 <sup>B</sup>	202.56±3.50 <sup>A</sup>

Tab. 1: quail egg weight (g), egg yolk weight (g), yolk colour grade (Roche yolk colour fan) and yolk total carotenoids (µg/g) (L.S.means±S.E.)



Tab. 2: quail egg total carotenoids content per week of feeding (µg/g)