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CAROTENOID PROFILING AS TOOL FOR VERIFYING EGG PRODUCTION CLAIMS IN THE UK?

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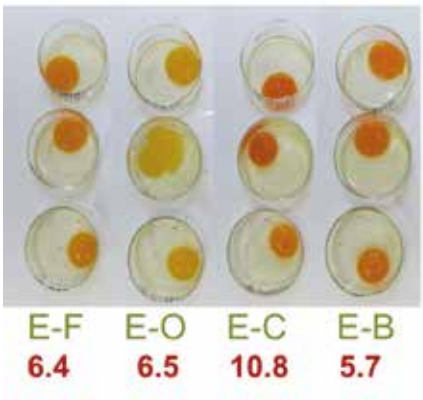
Keywords: eggs, carotenoids, production claims, HPLC-UV/VIS.

We developed and validated a method for the determination of production origin for eggs by (i) developing a carotenoid profiling method for hen eggs (and feed) and (ii) analysing hen eggs and feed from different productions methods [enriched caged (C), barn (B), free range (F) and organic (O)] and regions in the UK [England (E), Northern Ireland (NI), Scotland (S) and Wales (W)].

As part of the Defra project, FA0159, 18 eggs and a feed sample were collected by poultry officers from each of 16 different UK farms. On arrival at Fera Science Ltd, the egg samples were stored at 3 conditions (+4, +19 and +23 °C) for a 5 week period, generating 6 time points (week 0, 1, 2, 3, 4, 5). Individual eggs were taken from each farming system for week 0, 3 and 5, when stored at +4°C. In addition, at week 5, eggs stored at +19°C and +23°C were also sampled in order to give an indication of whether carotenoid profiles are affected by elevated temperatures. A total of 78 egg samples and 14 feed samples were analysed for carotenoids (capsorubin, capsanthin, lutein, zeaxanthin, citranaxanthin, β-cryptoxanthin, ethyl-8'-apo-β-carotene-8'-oate, β-apo-8'-carotenal, β-carotene and canthaxanthin) by HPLC-UV/VIS; see Figure 1 - carotenoids affecting colour of yolks.



Carotenoid	Wavelength [nm]
Capsorubin	479
Capsanthin	469
Lutein/Zeaxanthin	445
Canthaxantin	465
β-apo-8'-carotenal	455
Citranaxanthin	467
ethyl-8'-apo-β-carotene-8'-oate	442
β-cryptoxanthin	450
β-carotene	455

Figure 1. Picture of cracked eggs from different English production sites and measured total carotenoid concentrations (mg kg-1). The longer the wavelength the more red the carotenoid. Yolks of sample E-O were much lighter in colour, as the total carotenoid concentration consisted mainly of lutein/zeaxanthin, while E-F and E-B contained a mixture of carotenoids of similar overall concentrations; whilst E-C contained the highest amount of citranaxanthin.

Capsorubin and canthaxanthin were not detected in any of the egg samples, whereas capsanthin, lutein/zeaxanthin and β-carotene were detected in all samples; citranaxanthin and β-8'-apo-carotenal were absent in organic ones. Only lutein/zeaxanthin were present (≤ 1 mg kg-1) in all feed samples. This suggests that the carotenoids are accumulated within the egg yolk, as the concentrations ranged from 0.8 to 12.7 mg kg-1 for week 0 samples. The absence of citranaxanthin and β-8'-apo-carotenal in organic feed samples was also confirmed. Differentiation of organic farming practice using the procedure reported by van Ruth et al (2011) was not possible due to lack of the canthaxanthin marker in UK feed. But the presence of citranaxanthin and β-8'-apo-carotenal in non-organic egg samples might be used, as a marker in UK eggs, to differentiate them from organic ones.
Defra (UK) is gratefully acknowledged for funding this work as part of project FA0159.