Coloured carrot varieties as forage material for egg layers

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The effect of feeding different coloured carrot varieties during 4 weeks to egg laying hens on egg production and egg quality was studied. A total of 112 Hy-Line® Brown hens at age 22-25 weeks were divided into 4 treatments of each 4 replicates with 7 hens. All groups were fed a standard diet ad libitum. The experimental treatments were C) control – standard diet, O) standard diet plus orange carrots – variety Bolero, Y) standard diet plus yellow carrots – variety Rainbow, and P) standard diet plus purple carrots – variety Purple Haze. Carrots, 70 g/hen, were fed daily as fresh, whole roots. Feed intake, egg production and egg yolk quality were analysed during the feeding period. The yolk colour was measured objectively using a Minolta Chroma meter and expressed as L*, a*, and b* parameters representing lightness, redness and yellowness, respectively. Feed intake was significantly (P<0.001) higher in treatment C than in O, Y and P. The laying rate was highest (P<0.01) for hens given purple and yellow carrots compared with hens fed orange carrots, whereas the control did not differ significantly. Egg weights were significantly (P<0.01) highest in treatment C, whereas egg weights of groups fed carrots were similar. In total, yolk mass production increased from O, C, Y, to P with a significant (P<0.01) difference between treatment O and the other treatments. FC was significantly (P<0.001) highest in P and Y groups compared with C and O groups. Yolks from hens fed purple carrots were significantly (P<0.05) darker than the C egg yolks. All treatments differed significantly (P<0.001) in yolk redness (a*) and increased from C, Y, O, to P. The yolks were significantly (P<0.001) more yellow by treatment P, and least yellow in group C.

In conclusion, usage of specific carrot varieties as forage material significantly affected egg production, feed conversion and egg yolk quality. Especially, the, variety Purple Haze was beneficial for egg laying rate, egg and yolk mass production, FC, and yolk colour.

Keywords: laying hens; egg production; carrots, yolk colour, egg quality

Introduction

In organic egg production, there is a requirement of foraging material, which can be supplemented to the hens as e.g. silage or unprocessed crops. At the same time it is prohibited to use synthetic pigments in the feed to achieve a specific yolk colour. Consumers in Denmark are willing to buy organically produced eggs, which have a production share of ~15 % (Windhorst, 2005) and have expectations of receiving a high quality food also. In order to meet the demands of yolk colouring, different crops that contain xanthophylls e.g. maize and carrots (Hammershoj & Steenfeldt, 2005; Zia et al., 1994), chicory leaves (Horsedt et al., 2006), red pepper (Furuse et al., 1994) can be used as foraging material with effects on yolk colour and content of carotenoids. The traditional orange carrot contains mainly β-carotene, whereas other coloured carrot varieties ranging from white, yellow, red to purple differ in carotenoid compositions. In general, these varieties have higher levels of e.g. lutein...
and zeaxanthin, which do not possess vitamin A activity, hence is more efficiently absorbed and deposited into the egg yolk.

The aim was to study the effect of feeding laying hens with different coloured carrot varieties on egg production and egg yolk colour.

Materials and methods

A total of 112 Hy-Line® Brown hens were used in the experimental period of 4 weeks from 22-25 weeks of age. The hens were divided into 4 treatments of each 4 replicates with 7 hens in floor pens. All groups were fed an organic standard diet ad libitum, in which no synthetic pigments were added, and xanthophylls-rich feed sources were excluded. The four experimental treatments were C) control – standard diet, O) standard diet plus orange carrots (var. Bolero), Y) standard diet plus yellow carrots (var. Rainbow), and P) standard diet plus purple carrots (var. Purple Haze). The carrots were given daily as fresh whole roots in an amount of 70 g/hen/day. Feed intake, egg production and egg yolk quality were analysed during the 4-week experimental period. Yolk colour was analysed by Minolta Chroma Meter CR-300 (Minolta Co. Ltd., Osaka, Japan) with L*, a*, and b* parameters representing lightness, redness and yellowness, respectively.

Results and discussion

The results on feed intake and laying rate as mean value for the experimental period are given in Figure 1. Feed intake was significantly (P<0.001) higher in treatment C than in O, Y and P. The latter three groups were similar in carrot intake, which on average was close to the amount of carrots supplied each day. The laying rate was highest (P<0.01) for hens given purple and yellow carrots compared with hens fed orange carrots, whereas the control did not differ significantly.

The feed conversion of standard diet was significantly (P<0.001) highest in P and Y groups compared with C and O groups (data not shown). The egg weights were significantly (P<0.01) highest in treatment C with a mean value of 60.2 g, whereas all three carrot treatments (O, Y, and P) were similar in egg weights with a mean value of 58.8 g. The total yolk mass production per day increased from O, C, Y, to P with significant (P<0.01) difference between treatment O and the other treatments. This was a combined effect of both low laying rate and low yolk weight (data not shown) for hens fed...
orange carrots. In contrast, the high yolk mass production of hens fed purple carrots was mainly due to a high laying rate. In Figure 2, the mean yolk colour parameters are given. Yolks from hens fed purple carrots were significantly ($P<0.05$) darker than the C egg yolks. All treatments differed significantly ($P<0.001$) in yolk redness ($a^*$) and increased from C, Y, O, to P. The yolks were significantly ($P<0.001$) more yellow by treatment P, and least yellow in treatment C.

![Figure 2. Effect of different carrot varieties supplied as forage material on yolk colour parameters L* (lightness), a* (redness), and b* (yellowness). Treatment C = control, O = orange carrots (var. Bolero), Y = yellow carrots (var. Rainbow), and P = purple carrots (var. Purple Haze), n =32.](image)

In total, the results indicate that different carrot varieties influence both egg production and egg yolk colour differently. The purple carrot variety *Purple Haze* seems to have a high potential as forage material, due to its positive effects on both egg laying rate, yolk mass production, feed conversion and the egg yolk colour parameters.

It is suggested that the hens may benefit from the specific xanthophylls or other components in this carrot variety to obtain better performance and higher egg quality.

**References**


