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Effect of addition of marigold petals in poultry feed to increase the carotenoids content in egg yolk and to enhance yolk colour in laying hens

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ABSTRACT

An experiment was conducted in the year 2016-2017 in the Department of Horticulture, Assam Agricultural University, Jorhat to determine the effect of addition of marigold petals in poultry feed for increasing the carotenoid content in egg yolk and also to enhance the egg yolk colour in laying hens. The petals were supplemented with the basal diet in terms of carotenoid content viz: T_0 (Control), T_1(4mg carotenoid/kg diet), T_2(8mg carotenoid/kg diet) and T_3(12mg carotenoid/kg diet) The treatments interacted significantly with the days of feeding for the total carotenoid content (µg/g) in egg yolk both for fresh and dried petals. On analysis of egg yolk at three days interval for total carotenoid after starting supplemented diets, it was observed that the carotenoid accumulation in egg yolk increased from 3rd day of feeding to 30th day. The highest accumulation (38.82 µg/g) and (40.81µg/g) for fresh and dried petals respectively was recorded for T_3(12 mg carotenoid/kg diet) followed by T_2(8 mg carotenoid/kg diet) which were 29.34 µg/g and 30.57µg/g for fresh and dried petals respectively. However, in case of the control no such accumulation of carotenoid in egg yolk was observed upto 30th day after feeding normal diet. Highest yolk colour score, as estimated by DSM yolk colour fan was recorded for both fresh petal (10.73) and dried petal (10.8) for diet supplemented with 12 mg carotenoid per kg diet (T_3). The lowest colour score 7.26 was recorded for basal diet, *i.e.* control (T_0).

Key word: *Marigold petals, Carotenoid, Egg yolk, Yolk colour, Poultry*

Introduction

The color of egg yolk is one of the important factors of egg quality that should receive attention of the poultry producers as per expectation of the consumers. Consumers generally prefer yolk color ranging from golden yellow to orange (Vuilleumier, 1969). The poultry nutritionists should think for the alternative sources of natural carotenoids as pigmenting agents for egg yolk like marigold petal. Since some of the artificial colour additives have cancerous effects in consumers as suggested by Oktay and Olgun in 1972, the natural colour additives are preferred for improving egg yolk pigmentation. Marigold flower petals are a significant source of the carotenoids (Xanthophyll) and have a much higher concentration of this pigment compared to other plant materials (Verghese, 1998). The carotenoids

extracted from petals of marigold are the major source of pigment for poultry industry as a feed additive to intensify the yellow colour of egg yolks and broiler skin (Narsude *et al*., 2010 and Kaul *et al*., 1997). In the era of globalization value addition to the products of flower crop could further enhance the commercialization process. Marigold growers could be greatly benefitted through value addition in the form of marigold petals as an additive to poultry feed to improve the pigmentation of the bird's fat, skin and egg yolk. Carotenoids provide considerable health benefit. The finding of Handelman *et al.* (1999) indicated that higher intake of carotenoids such as lutein and zeaxanthin reduced the risk of age-related macular degeneration in the retina of eye. Dry petals of marigold flower contain about 90 per cent (w/w) carotenoids. The petals are dried in such condition that maximum carotenoids retain in them. These dried petals and concentrates are used as feed additives to improve the pigmentation of the poultry skin and the eggs yolk. Few industries in India, particularly in Andhra Pradesh, Karnataka and Maharashtra are exporting the powder of orange colored marigold flowers (Singh *et al.*, 2015). Keeping these in view, the present investigation was carried out to determine the effect of addition of marigold petals in poultry feed to increase the carotenoid content in egg yolk and to enhance yolk colour in laying hens.

Materials and Methods

The experiment was carried out for 30 days using 60 numbers of six months old poultry Vanraja hens at Instructional Poultry Farm, Department of Animal Husbandry and Dairying, AAU, Jorhat. The hens were randomly distributed into 12 bamboo cages with four dietary treatments and 3 replicates of each. Four different experimental diets supplemented with four different doses of carotenoid per replicate were given to 60 hens for 30 days Hens were provided free access to feed and water during experimental period. The control group received a standard diet with no added carotenoids. The other three groups received basal diet supplemented with different levels of marigold petals. Design and layout for determination of total carotenoid content in egg yolk as follows:

During 30 days of experimental period the egg weight yolk colour and yolk weight was determined at every three day intervals.

The yolk colour was visually evaluated using DSM yolk colour fan.

Total carotenoid content (µg/g) =

$$\frac{\text{Absorbance} \times \text{volume}(\text{ml}) \times 10}{\text{Absorbancecoefficient}\ (2592) \times \text{Sample weight}\ (\text{g})}$$

Total Carotenoid content was determined according to Rodriguez-Amaya (1999).

Results and Discussion

Data revealed that the treatments interacted significantly with the days of feeding for the total carotenoid content (µg/g) in egg yolk both for fresh and dried petals. It is evident from the Table 1 that the diet supplemented with marigold petals had a profound effect on carotenoid content of egg yolk. On analysis of egg yolk at three days interval for total carotenoid after starting supplemented diets, it was observed that the carotenoid accumulation in egg yolk increased from 3rd day of feeding to 30th day (the final day of analysis) Fig. 1 and 2 respectively. Similar findings were reported by The highest accumulation (38.82 µg/g) and (40.81µg/g) for fresh and dried petals respectively was recorded for T_3(12 mg carotenoid/kg diet) followed by T_2(8 mg carotenoid/kg diet) which were 29.34 µg/g and 30.57µg/g for fresh and dried petals respectively. However, in case of the control no such accumulation of carotenoid in egg yolk was observed upto 30th day after feeding normal diet. Similar findings were reported by Kardas *et al.* (2006) where basal diet supplemented with 0.2% marigold extract recorded the highest carotenoid content (39.0 µg/g) in egg yolk as compared to other additives such as to-

Treatment	Dose	Quantity of fresh petal		Quantity of dried petal	
		Per kg diet	Per hen per day	Per kg diet	Per hen per day
T_0	Control	No petals	No petals	No petals	No petals
T_1	4mg carotenoid/kg diet	13.6 g	2.00 g	11.7 g	1.75 g
T_2	8mg carotenoid/kg diet	26.7 g	4.00 g	23.1 g	3.45 g
T_3	12mg carotenoid/kg diet	39.6 g	6.00 g	34.3 g	5.14 g

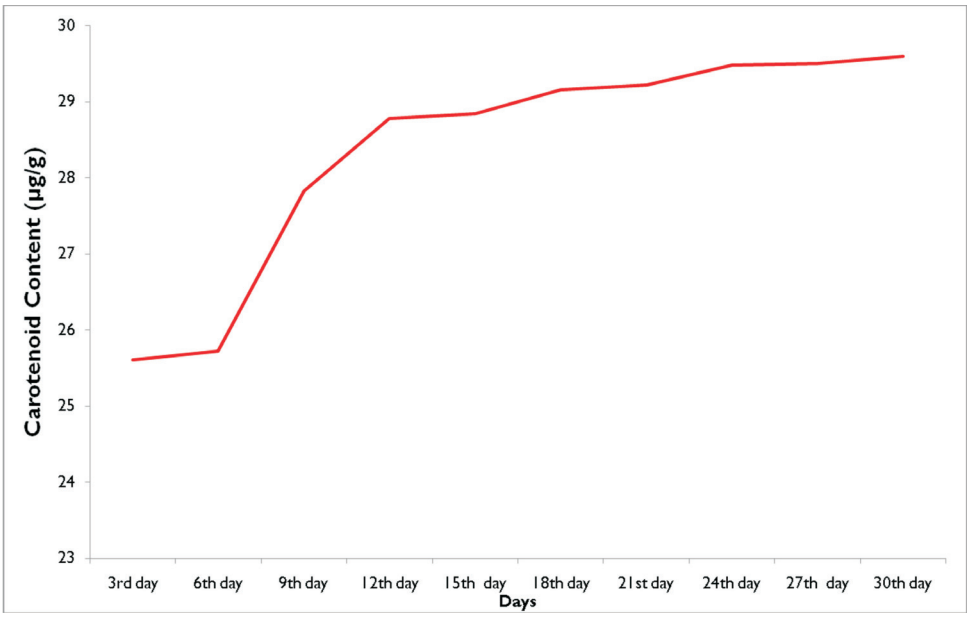

Fig. 1. Mean values of egg yolk carotenoid 30thdays after feeding basal diet supplemented with fresh marigold petal

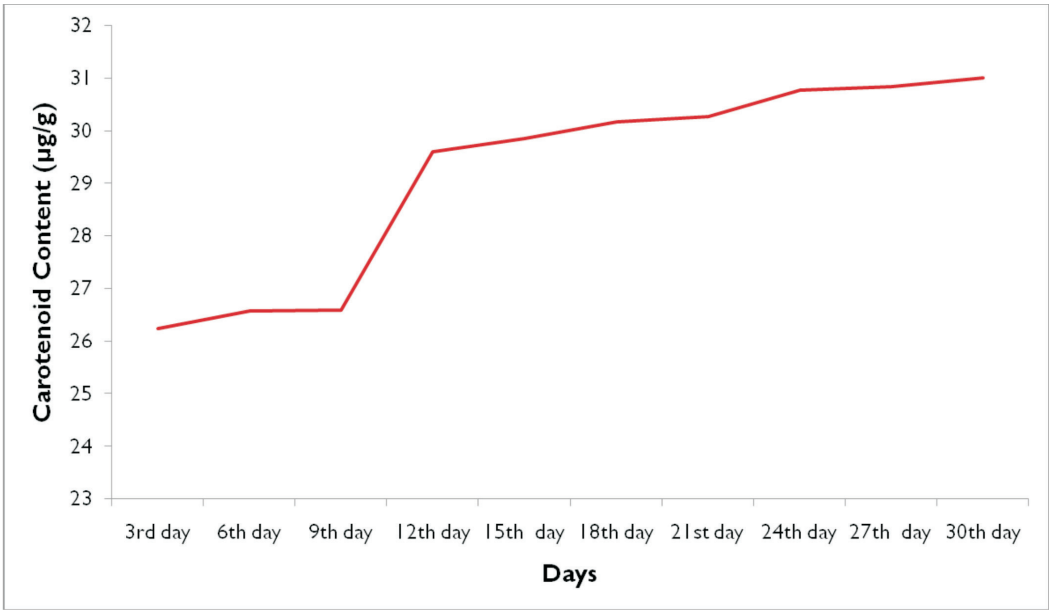

Fig. 2. Mean values of egg yolk carotenoid 30th days after feeding basal diet supplemented with dried marigold petal

mato powder and alfalfa. Hasin *et al*. (2006) reported that when the basal diet was supplemented with 4% marigold petal, 0.745 mg xanthophylls was consumed by the hen/day as compared to 4% orange skin (0.397 mg/hen/day). The lutein and zeaxanthin content in yolk increased by approximately 11.5 and 5.9 mg/kg dry matter, respectively, after the MFE (Marigold Flower Extract) addition of 350 mg/kg.(Skrivan *et al.*, 2015).

The treatments (different levels) interacted non significantly with days of feeding for both egg and yolk weight.(Table 2 and 3) Similarly, Rowghani *et al.* (2006); Karadas *et al.*, (2006) and Sujatha *et al.* (2015), reported that feeding has no effect on egg

Table 1. Total carotenoid content (µg/g) of egg yolk after feeding basal diet supplemented with marigold petals with different levels of carotenoid

Day	T_0 (Control)		T_1 (4 mg carotenoid per kg diet)		T_2 (8 mg carotenoid per kg diet)		T_3 (12 mg carotenoid per kg diet)	
	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh
3rd	20.25±0.15a	20.26±0.15a	23.07±0.13d	22.41±0.96b	27.62±0.33f	27.05±0.22b	34.03±0.59f	32.73±0.56c
6th	20.25±0.15a	20.26±0.15a	23.23±0.02d	22.50±1.09b	27.83±0.04f	27.15±0.34b	35.03±0.17f	32.97±0.30c
9th	20.26±0.07a	20.26±0.07a	25.93±0.34c	24.95±0.21a	28.92±0.37e	27.65±0.82b	39.29±0.30e	38.49±2.06b
12th	20.26±1.16a	20.26±1.16a	26.05±0.26c	25.04±2.97a	30.75±0.02d	29.68±1.15a	41.30±1.01d	40.01±0.58ab
15th	20.25±0.05a	20.26±0.05a	26.46±0.08b	25.27±1.32a	30.89±0.03cd	29.86±0.27a	41.82±0.68cd	40.15±1.64ab
18th	20.25±0.01a	20.26±0.01a	26.59±0.19b	25.87±0.08a	31.13±0.09bc	29.94±2.49a	42.72±0.90bc	40.60±0.50a
21st	20.25±0.03a	20.26±0.03a	26.65±0.08b	25.98±0.47a	31.27±0.01b	29.96±0.63a	42.93±0.79ab	40.71±0.86a
24th	20.26±0.04a	20.26±0.04a	27.04±0.06a	26.21±0.29a	32.30±0.10a	30.59±1.25a	43.48±0.23ab	40.86±0.39a
27th	20.26±0.31 a	20.26±0.31a	27.14±0.14a	26.23±0.17a	32.33±0.01a	$30.62±1.39_a$	43.59±0.18ab	40.96±0.84a
30th	20.26±0.01a	20.26±0.01a	27.30±0.28a	26.48±0.11a	32.58±0.07a	30.94±0.36a	43.90±0.04a	40.98±0.51a
S. Ed.	0.32	0.32	0.15	0.93	0.13	0.91	0.48	0.81
CD at 5%	**0.66**	**0.66**	**0.33**	**1.95**	**0.28**	**1.91**	**1.01**	**1.69**

Table 2. Egg weight(g) at different levels of marigold petal feeding

Treatments	Mean	
	Fresh petal	Dried petal
T_0 (Control)	60.24	60.23
T_1 (4 mg carotenoid per kg diet)	60.23	60.23
T_2 (8 mg carotenoid per kg diet)	60.23	60.23
T_3 (12 mg carotenoid per kg diet)	60.23	60.24
S. Ed.	0.40	0.41
CD at 5%	NS	NS

Table 3. Yolk weight (g) at different levels of marigold petal feeding

Treatments	Mean	
	Fresh petal	Dried petal
T_0 (Control)	19.29	19.32
T_1 (4 mg carotenoid per kg diet)	19.26	19.30
T_2 (8 mg carotenoid per kg diet)	19.25	19.28
T_3 (12 mg carotenoid per kg diet)	19.29	19.28
S. Ed.	0.28	0.22
CD 5%	NS	NS

weight and yolk weight.

Data revealed that the highest yolk colour score, as estimated by DSM yolk colour fan was recorded for both fresh petal (10.73) and dried petal (10.8) for diet supplemented with 12 mg carotenoid per kg diet (T_3). These were followed by diet supplemented with 8 mg carotenoid per kg diet (T_2) *i.e.* 8.80 and 8.93 for both fresh and dried petals, respectively (Table 4) The lowest colour score 7.26 was recorded for basal diet *i.e.* control (T_0). Sujatha *et al.* (2015) reported that yolk colour (Roch Yolk colour score) increased from 4 to 8 feeding basal diet supplemented with 3g dried marigold petals per hen per day. Rowghani et al in 2006 observed highest colour pigmentation with basal diet supplemented with 3% Red Pepper meal.

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Table 4. Egg Yolk colour after feeding marigold petal supplemented diet

Treatments	DSM colour score	
	Fresh petal	Dried petal
T_0 (Control)	7.20 ± 0.20d (2.77)	7.33 ± 0.11d(2.79)
T_1 (4 mg carotenoid per kg diet)	7.93 ± 0.11c (2.90)	8.00 ±0.14 c(2.91)
T_2 (8 mg carotenoid per kg diet)	8.80 ±0.24 b (3.04)	8.93 ± 0.11b(3.07)
T_3 (12 mg carotenoid per kg diet)	10.73 ± 0.46a (3.28)	10.8 ± 0.20 a(3.27)
S. Ed.	0.02	.03
$CD_{5\%}$	**.05**	**.07**

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