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Effects of Breed and Storage Duration on the Beta-Carotene Content of Egg Yolk

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Abstract: Effects of breed (Harco, White Leghorn and Local breeds) and storage durations (point of lay, 1-week, 2-week and 3-week) on the beta (ß)-carotene contents of egg yolk were studied using one hundred and twenty eggs for each breed. The ß-carotene contents of the egg yolks were determined using spectrophotometer and data obtained were analyzed using ANOVA and differences between means were separated using DNMRT. The mean concentration in mg/g of ß-carotene obtained for each breed and at different storage durations were: 0.08 (Harco), 0.06 (White Leghorn) and 0.06 (local breed) at point of lay; 0.031 (Harco), 0.047 (White Leghorn) and 0.54 (Local breed) for 1-week old eggs; 0.014 (Harco), 0.027 (White Leghorn) and 0.039 (Local breed) at two weeks and 0.000 (Harco), 0.004 (White Leghorn) and 0.024 (Local breed) at three weeks of age. Generally, the results revealed that eggs from Harco breed had the highest and most unstable concentration of ß-carotenes, while the eggs from the local breed had the greatest propensity to retain ß-carotene. Consequently, eggs are best consumed at the point of lay or as soon as possible especially eggs from Harco breed if the ß-carotene content is desired. Furthermore, eggs from local chickens may be stored for a longer period without remarkable decrease in ß-carotene content of the egg yolk. The study further recommends to researchers and poultry breeders who are interested in improving the beta-carotene content as well as the storage duration of eggs to consider seriously crossing of black harco breed with local breed.

Key words: Breed, storage duration, beta-carotene and egg yolk

INTRODUCTION

Beta-carotene is the most important group of carotene which services as the primary source of vitamin A in the diet of man and farm animals (Olson, 1996). Vitamin A plays some key roles in both animal and human nutrition in that it is indispensable for good night vision, normal development of bone and teeth, development of healthy skin as well as mucous membrane (Maynard *et al*., 1979; Coultate, 1996; Taylor *et al*., 1996; Geoffrey, 1998; Ross, 1999; Thomas, 2006).

There are diverse sources of beta-carotene in the diet and the sources include; sweet potatoes, carrots, kale, spinach, lettuce, fresh thyme, water squash, turnip greens, cantaloupe, collard green, romaine and broccoli (Groff *et al*., 1995). Egg yolk, milk, butter and liver are the major animal sources of beta-carotene. In spite of these sources, deficiency in dietary beta-carotene is prevalence in both animal and human nutrition. The reason being partly due to the low level of concentrations of the beta-carotene in these nutrients and partly due to the unstable nature of beta-carotene. The study was therefore designed to ascertain the effects of poultry breed and storage duration of eggs on the beta-carotene content of egg yolk.

MATERIALS AND METHODS

The study was conducted at the Poultry Research Unit of the Department of Animal Science, Faculty of Agriculture, University of Nigeria, Nsukka, Enugu State. Ninety pullets comprising, thirty each of local, black harco and white leghorn breeds constitute the experimental chickens. The pullets were housed individually on battery cage and conventional pullet mesh was fed *ad libitum*. All the routine management practices such as inoculation, prophylactic application of certain drugs and chemicals to prevent incidence of disease as well as curative measures were applied as and when necessary.

Design of the experiment: The experiment was conducted under a 2 x 3 factorial in CRD to test the effects of breed, storage duration and their interactions on the beta-carotene contents of egg yolk. Breed was tested on three levels with equal replicates of thirty pullets; while the storage duration was tested on four levels. The statistical model used:

$$Y_{ijk} = \mu + B_i + S_j + (BS)_{ij} + e_{ijkl}$$

Where:
Y_{ijk}-is the observed beta-carotene index
μ-the population mean;
B_i-the effect of ith breed, $_i$ = 1, --, 3
S_j-the effect of jth storage duration of the pullet, j = 1, 2
$(BS)_{ij}$-is the interaction between breed and storage duration and
e_{ijk}-is the error term associated with the observations.
Assumptions; error term is independently, identically and normally distributed, with zero mean and constant variance, that is, iind (0, $*^2$).

Sample collection: Eggs laid were collected thrice a day and properly identified. Thirty eggs per breed were analyzed for beta-carotene contents on the day they were laid; another thirty eggs per breed were analyzed seven days after they were laid. Similarly, thirty eggs each were analyzed after fourteen and twenty-one days of holding (preservation).

Analytical procedure: The egg was gently broken to recover the egg yolk and electric weighing balance was used to get the actual weight of the yolk. The egg yolk was homogenized in 50 ml of cold acetone. Thereafter, the mixture was filtered and the filtrate collected in 20 ml of petroleum ether. It was rinsed in distilled water to wash off acetone. Carotene layer was collected in 25 ml standard flask through a funnel with cotton wool saturated with sodium sulphate. Petroleum ether was added to make up the volume to 25 ml mark. Then, using a spectrophotometer, the absorbance was read at 450 nm and beta-carotene concentration in mg/g of the egg yolk is given as:

$$\text{Beta-Carotene Conc.} = \frac{\text{A x Volume (ml) x } 10^4}{A^{10}\text{\% 1cm x Sample Weight (g)}}$$

Where:
A = Absorbance
A^{10}% 1 cm = 2592 to beta-carotene
Volume = 25 ml
Sample Weight = weight of egg yolk

Statistical analysis: Data collected were subjected to analysis of variance (ANOVA) appropriate for a 2 x 3 factorial in a Completely Randomized Design (CRD). The differences between means were separated using Duncan's New Multiple Range Test (DNMRT). SPSS (2004) Statistical Package was used for data analysis.

RESULTS AND DISCUSSION

The mean concentrations of beta-carotene in mg/g obtained for the three breeds of chicken and at various storage durations are given in Table 1.

Table 1: Mean concentrations of beta-carotene in mg/g obtained for the three breeds of chicken and at various storage durations

	Breed		
Storage duration	Black harco	White leghorn	Local breed
Point of lay	0.080^b	0.060^a	0.060^a
1-Week	0.031^a	0.047^b	0.054^c
2-Week	0.014^a	0.027^b	0.039^c
3-Week	0.000^a	0.004^b	0.027^c

^{a,b,c}Means bearing different superscripts on the same row are significantly different ($p<0.05$)

At point of lay, the beta-carotene content of egg yolk is significantly highest in black harco breed, but similar in white leghorn and local breeds ($p<0.05$). As storage duration increases, the beta-carotene content declines irrespective of breed. However, the rate of depreciation as storage duration progresses is highest in harco breed and least in local breed. This implies that beta-carotene content of egg yolk is an inherent factor which is breed determined and storage duration affects its stability. Though, there is scarcity of literature reports on the effect breed on beta-carotene content of egg yolk; research reports abounds that beta-carotene depreciates with time irrespective of its source (Groomes and Groomes, 1979; Bendich and Olson, 1989; Groff *et al*., 1995; Rock *et al*., 1996; Leo and Lieber, 1999; Ross, 1999; Thomas, 2006).

Conclusion: The study recommends that eggs from black harco breed and to a lesser extent white leghorn should be consumed within the week they were laid, if optimal beta-carotene level is desirable. Appreciable quantity of beta-carotene level can still be obtained from egg yolk of local chickens at second week of laying. In addition, poultry breeders who are interested in improving the beta-carotene content as well as the storage duration of eggs should consider seriously crossing of black harco breed with local breed.

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