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Seasonal variation in egg phenotype and chemical composition of collard dove (*Streptopelia decaocto*) in Baghdad

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Abstract

A total of 36 freshly collared dove (*Streptopelia decaocto*) eggs without developed embryo were collected from four different regions of Baghdad city to determined egg phenotype characteristics included egg shape, dimensions, weight, volume, specific gravity and weight and chemical composition which included protein, lipids and ash percentages of the egg components during Spring and Autumn seasons of 2013. Results revealed that significant differences (P<0.05) were appeared in egg breadth and shape index values due to season. Egg breadth and shape index values were high in Autumn (2.42 ±0.46cm and 78.06 ±1.47) compared with Spring (2.40 ±0.46cm and 77.67 ±1.44), no significant differences in egg length values due to season were noticed, also egg weight and volume values were high in Autumn (9.11 ±0.24gm and 9.23 ±0.22cm^3) compared with Spring (9.06 ±0.21cm and 9.05 ±0.23cm^3) in the same time specific gravity were low in Autumn (0.99 ±0.24). protein percentage were ranged from 20.30 to 20.32%, lipids percentage were ranged from 8.54 to 8.57%, ash percentage were ranged from 0.96 to 0.98% during Spring season, whereas protein percentage ranged from 20.32 to 20.34%, lipids percentage were ranged from 8.56 to 8.59%, ash percentage were ranged from 0.96 to 0.98% during Autumn season. Statistical analysis revealed that significant differences (P<0.05) were appeared in egg protein and lipids percentages values due to season. It can be concluded that the season has a significant effect on the phenotype and chemical composition of collared dove (*Streptopelia decaocto*) egg in Baghdad.

Keywords: Collared dove, *Streptopelia decaocto*, Eggs, Phenotype, Chemical composition, Baghdad.

Introduction

Collared dove (*Streptopelia decaocto*) is actually member of the birds of Iraq, they have well adapted in Baghdad areas, nesting on the top of buildings, window sills and any other place they can build a stable nest. The collared dove, also spelled Eurasian collared dove is one of the great colonizers of the avian world. Its original range was warmer temperate regions from southeastern Europe to Japan (Allouse, 1962; Moudhafer, 2006). In Iraq, collared dove has two breeding seasons, first is between April to May and the second is between September to October (Marchant, 1963). Collared doves usually re-nested in the same nest or very close by, inter clutch intervals were noticed, 89% of completed clutches were of 2 eggs, the rest of only 1, the mean fresh egg weight was 10.0gm (Robertson, 1990).

Seasonal differences in food resources seem to explain latitudinal (and, similarly, other geographic and habitat) trends in clutch size. Food is also obviously the key to the difference between onshore and offshore feeding seabirds, the former can rear more chicks because they can visit the nest with food more often. Competition for food also probably explains why clutch sizes are smaller in dense rather than sparse populations, declining food resources also explain the evolution of smaller clutch sizes in late breeders (Aparicio, 1999).

The birds egg is one of most complex and highly differentiated reproductive cell, germinal cell accumulated relatively enormous amounts of food substances (yolk and albumen material) and all are enclosed in protective structures (shell), birds egg diverge widely in shape, volume, weight and the amount of yolk and albumen material (Romanoff and Romanoff, 1949). The shape of the egg is recognizable species characteristic, species lay egg diverge widely from oval to conical shape, with one end rounded and the other more pointed (Stadelman and Cotterill, 1995).

The objective of this study was to determined the effect of season on egg phenotype characteristics and egg chemical composition of collared dove (*Streptopelia decaocto*) in Baghdad.

Materials and Methods

A total of 36 freshly collared dove (*Streptopelia decaocto*) eggs without developed embryo were collected from four different region of Baghdad city (A: north Baghdad, B: east Baghdad, C: south Baghdad and D: west Baghdad) during two season, Spring and Autumn of 2013.

Egg phenotype: Egg shape were determined according to the description and sketches made by Romanoff and Romanoff (1949). Egg shape index determined using the micrometer according to Stadelman and Cotterill (1995) using the equation:

$$\text{Egg shape index} = \frac{\text{egg breadth (short circumference) mm}}{\text{egg length (long circumference) mm}} \times 100$$

Egg weight determined using a very sensitive digital Sartorius balance according to Stadelman and Cotterill (1995).

Egg volume determined according to Romanoff and Romanoff (1949) using the equation:

Egg volume $cm^3 = 0.51\ LB^2$, L: egg length, B: egg breadth.

Egg specific gravity determined according to Stadelman and Cotterill (1995) using the equation:

$$\text{Egg specific gravity gm/cm}^3 = \frac{\text{egg weight (gm)}}{\text{egg volume (cm}^3\text{)}}$$

Chemical analyses: The yolk and the albumen both were distributed into three replicates of glass beakers. protein, lipid a contents in albumen and yolk were carried out according to AOAC (1980), all these measurements were done in triplicates. Ash determined by ashing samples using muffle furnace oven at 600°C for 6 h. Lipids analysis was conducted on all samples using mixture of chloroform: methanol (1:1) and stirred for 20 min using magnetic stirrer for several rinsing times. Protein determined by the method of semi-microkjeldal determination of N% and the values obtained multiplied with 6.25 to calculate protein%.

Results and Discussion

Collared dove egg breadth, length and shape index values were verified among the four different regions of Baghdad and the average values were 2.40 cm, 3.09 cm and 77.67 respectively during Spring season whereas the average values were 2.42 cm, 3.10 cm and 78.06 respectively during Autumn season (Table 1), statistical analysis revealed that significant differences ($P<0.05$) were appeared in egg breadth and shape index values due to season. Egg breadth and shape index values were high in Autumn compared with Spring, no significant differences in egg length values due to season were noticed. Collared dove egg just like most birds egg have an oval shape, with one end rounded and the other more pointed. This shape results from the egg being forced through the oviduct. Muscles contract the oviduct behind the egg, pushing it forward (Sturkie, 1986). The egg's wall is still shapeable, and the pointy end develops at the back side. Cliff-nesting birds often have highly conical eggs. They are less likely to roll off, tending instead to roll around in a tight circle; this trait is likely to have arisen due to evolution via natural selection. In contrast, many hole-nesting birds have nearly spherical eggs (Romanoff and Romanoff, 1949).

Collared dove egg have an egg weight ranged from 9.06 to 9.07 gm with an average value 9.086 gm, its volume ranged from 8.92 to 9.18 cm^3 with an average value 9.05 cm^3, the egg specific gravity ranged from 0.99 to 1.02 gm/cm^3 with an average value 1.01 gm/cm^3 during Spring season, whereas egg weight ranged from 9.10 to 9.12 gm with an average value 9.11 gm, its volume ranged from 9.15 to 9.29 cm^3 with an average value 9.23 cm^3, the egg specific gravity ranged from 0.98 to 0.99 gm/cm^3 with an average value 0.99 gm/cm^3 during Autumn season (Table 2), statistical analysis revealed that significant differences ($P<0.05$) were appeared in egg weight, volume and specific gravity values due to season, egg weight and volume values were high in Autumn compared with Spring in the same time specific gravity were low in Autumn.

Al-Obaidi (2010) recorded that collared dove eggs were oval shaped and the average values of egg breadth, length and shape index were 2.42 cm, 3.11 cm and 77.81 respectively, the average values of egg weight, volume and specific gravity were 9.08 gm, 9.15 cm^3 and 0.99 gm/cm^3 in four different regions of Baghdad city during the period from February 2nd to June 30th of 2010.

Stadelman and Cotterill (1995) explain that the egg weight is expressed in terms of size, there is an enormous range in egg size among different species and within the species between individuals. The size of the eggs laid by one individual may differ widely from those laid by another of the same species and breed, egg size influenced by climate, the amount of available food, parents body size, evolutionary status and some other factors.

Table (3) shows egg chemical composition (the mixture of albumen and yolk), protein percentage were ranged from 20.30 to 20.32%, lipids percentage were ranged from 8.54 to 8.57%, ash percentage were ranged from 0.96 to 0.98% during Spring season, whereas protein percentage ranged from 20.32 to 20.34%, lipids percentage were

ranged from 8.56 to 8.59%, ash percentage were ranged from 0.96 to 0.98% during Autumn season. Statistical analysis revealed that significant differences (P<0.05) were appeared in egg protein and lipids percentages values due to season, egg protein and lipids percentages values were high in Autumn compared with Spring, whereas no significant differences in egg ash values due to season were noticed.

Birds are grouped according to the relative amounts of the yolk and albumen, they fall naturally into two classes. Egg in which the yolk constitutes between 15 to 20 % of the total weight (lower percentage of yolk and lipids) belong to the Altricial species class, egg in which the yolk constitutes between 30 to 40 % of the total weight (high percentage of yolk and lipids) belong to the Precocial species class (Romanoff and Romanoff, 1949).

The yolk has the greatest food values, it contains a mixture of proteins, fats and carbohydrates in a watery medium (Marshall, 1960), the relatively large yolk assures a fairly advanced stage of development in the young at hatching, but in species that lay small yolked eggs the young are helpless nesting. In addition, most Altricial birds like eagle and dove lay eggs that have relatively thin shells as well as small yolk (Romanoff and Romanoff, 1949).

Table (1): Effect of season on egg breadth, length and shape index of collared dove in Baghdad.

Season	Regions	Egg breadth (cm)	Egg length (cm)	Egg shape index
Spring	A	2.38 ±0.46	3.09 ±0.60	77.02 ±1.42
	B	2.40 ±0.43	3.09 ±0.61	77.67 ±1.46
	C	2.41 ±0.44	3.10 ±0.63	77.41 ±1.43
	D	2.39 ±0.46	3.09 ±0.61	77.34 ±1.48
	Average	2.40 ±0.46	3.09 ±0.61	77.67 ±1.44
Autumn	A	2.42 ±0.47	3.11 ±0.64	77.81 ±1.46
	B	2.41 ±0.45	3.09 ±0.63	77.99 ±1.45
	C	2.41 ±0.46	3.10 ±0.63	77.74 ±1.46
	D	2.42 ±0.45	3.11 ±0.65	77.81 ±1.44
	Average	2.42 ±0.46	3.10 ±0.64	78.06 ±1.47
Significant		*	N.S.	*

*Significant (p<0.05), N.S. no significant differences in traits values among seasons

Table (2): Effect of season on egg weight (gm), volume (cm^3) and specific gravity (gm/cm^3) of Collared dove in Baghdad.

Season	Regions	Egg weight (gm)	Egg volume (cm^3)	Egg specific gravity (gm/cm^3)
Spring	A	9.07 ±0.21	8.92 ±0.22	1.02 ±0.27
	B	9.06 ±0.24	9.08 ±0.21	1.00 ±0.27
	C	9.06 ±0.22	9.18 ±0.23	0.99 ±0.24
	D	9.06 ±0.23	9.00 ±0.21	1.01 ±0.26
	Average	9.06 ±0.21	9.05 ±0.23	1.01 ±0.25*
Autumn	A	9.12 ±0.24	9.29 ±0.20	0.98 ±0.26
	B	9.10 ±0.24	9.15 ±0.22	0.99 ±0.23
	C	9.11 ±0.22	9.18 ±0.21	0.99 ±0.24
	D	9.11 ±0.23	9.29 ±0.21	0.98 ±0.26
	Average	9.11 ±0.24*	9.23 ±0.22*	0.99 ±0.24
Significant		*	*	*

*Significant (P<0.05) differences in traits values among seasons

Table (3): Effect of season on egg protein (%), lipids (%) and ash (%) of collared dove in Baghdad.

Season	Regions	Egg protein (%)	Egg lipids (%)	Egg ash (%)
Spring	A	20.31 ±0.33	8.55 ±0.22	0.98 ±0.13
	B	20.32 ±0.36	8.53 ±0.26	0.95 ±0.14
	C	20.30 ±0.34	8.57 ±0.24	0.96 ±0.10
	D	20.30 ±0.32	8.54 ±0.23	0.96 ±0.13
	Average	20.31 ±0.34	8.54 ±0.24	0.96 ±0.13
Autumn	A	20.32 ±0.35	8.58 ±0.25	0.97 ±0.12
	B	20.34 ±0.35	8.58 ±0.24	0.96 ±0.14
	C	20.33 ±0.36	8.59 ±0.25	0.98 ±0.13
	D	20.32 ±0.34	8.56 ±0.25	0.96 ±0.11
	Average	20.33 ±0.25	8.58 ±0.25	0.97 ±0.13
Significant		*	*	N.S.

*Significant ($p<0.05$), $^{N.S.}$ no significant differences in traits values among seasons

In addition to egg size, maternal investment in offspring quality in the form of different egg components such as lipids, immune factors, hormones and antioxidants critically influences offspring development and survival in many taxa (Bernardo, 1996; Hasselquist and Nilsson, 2009). Maternally-derived immunoglobulins provide the primary form of humoral immune defense for the offspring, as underdeveloped young cannot synthesize them (Grindstaff *et al.*, 2003). Yolk lipids and its soluble can affect offspring development and phenotype in many ways, for example growth, immunity, behavior and plumage traits (Groothuis *et al.*, 2005). Carotenoids are antioxidants that reduce lipid peroxidation in the embryo, and they can also enhance immune function (Blount *et al.*, 2002). Deposition of several egg components is known to be affected by environmental or social conditions (e.g. food availability, parasite load or quality of mates) *within* populations (Groothuis *et al.*, 2005; Blount *et al.*, 2002). To our knowledge only very few studies have estimated large-scale geographical variation *among* populations in egg components (or any maternal effects) in any species (with the exception of egg size). Most of the existing studies in birds have compared deposition into eggs in two contrasting environments (Hahn et al., 2005), but these results suggest that populations could differ in several maternally-derived egg components.

Conclusion

It can be concluded that the season has a significant effect on the phenotype and chemical composition of collared dove (*Streptopelia decaocto*) egg in Baghdad, which will influences offspring development and survival.

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