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Identification of inorganic elements in egg shell of some wild birds in Baghdad

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Summary

The objective of this study is the identification of inorganic elements in egg shell of some wild birds including House Sparrow, White- eared Bulbul, Collared Dove and Rock Dove. Samples of eggs from these birds were collected from Baghdad city during 2011. Egg shell were analysed for ash, macro-elements and micro- elements including Ca, P, Mg, Fe, K, Mn, B, Zn, Co, Cr and Pb. The findings revealed that the ash percentage was high in egg shell of all birds under study which were consecutively 1.73, 1.72, 1.79 and 1.78 % for House Sparrow, White- eared Bulbul, Collared Dove and Rock Dove, Ca percentage was the highest percentage among the other elements which were 97.3, 97.4, 97.8 and 97.8 % respectively, where as P and Mg were ranging between 0.85 and 0.89 %. Shells of House Sparrow eggs were high in Cr, at the same time, the shells of White- eared Bulbul eggs were high in K, and those of Collared dove and Rock dove were high in Fe, Mn, and B. Percentage of Pb in egg shell of all studied birds were low.

تشخيص العناصر اللاعضوية في قشرة بيض بعض الطيور البرية في بغداد

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الخلاصة

أستهدف البحث الحالي تشخيص العناصر اللاعضوية في قشرة بيض بعض الطيور البرية المحلية والتي شملت العصفور الدوري (House Sparrow) والبلبل (White- eared Bulbul) والحمامة الفاختة (Collared Dove) والحمامة المنزلية (Rock Dove) . تم جمع عينات البيض من هذه الطيور في مدينة بغداد خلال عام 2011 وتم تحليل محتوى قشرتها من الرماد(Ash) والعناصر الكبرى والعناصر الصغرى التي شملت على Ca ، P ، Mg ، Fe ، K ، Mn ، B ، Zn ، Co ، Cr وPb . وقد بينت النتائج أن نسبة الرماد كانت مرتفعة في قشرة بيض الطيور الأربعة قيد الدراسة وقد بلغت نسبها (1.73، 1.72 ، 1.79 و 1.78) % لكل من العصفور الدوري والبلبل والحمامة الفاختة والحمامة المنزلية على التوالي ، وكانت نسبة عنصر Ca الأعلى من بين العناصر اذ بلغت(97.3 ، 97.4 ، 97.8 و 97.8)% على التوالي في حين تراوحت نسب عنصري P و Mg بين(0.85 و 0.89)% ، وقد تميزت قشرة بيض العصفور بارتفاع محتواها من عنصر Cr في حين تميزت قشرة بيض البلبل بارتفاع محتواها من عنصر K أما قشرة بيض كل من الحمامة الفاختة والحمامة المنزلية فقد كانت مرتفعة في محتواها من عناصر Fe ، Mn و B ، ولم تكن نسبة عنصر Pb مرتفعة في قشور البيض للطيور الأربعة قيد الدراسة.

Introduction

Minerals are inorganic nutrients or substances, usually required in small amounts from less than 1 to 2500 mg per day, present in all body tissues and fluids and their presence is necessary for the maintenance of certain physicochemical processes which are essential for life. Although, they yield no energy, they have important roles to play in many activities in the body (1,2). Every form of living matter requires these inorganic elements or minerals for their normal life processes (3,4). Minerals may be broadly classified as macro (major) or micro (trace) elements. The third category is the ultra trace elements. The macro-minerals include calcium, phosphorus, magnesium and sodium, while the micro-elements include iron, copper, cobalt, potassium, iodine, zinc, manganese, molybdenum, fluoride, chromium,

selenium and sulfur (2). The macro-minerals are required in amounts greater than 100 mg/dL and the micro-minerals are required in amounts less than 100 mg/dL (5). The ultra trace elements include boron, silicon, arsenic and nickel which have been found in animals and are believed to be essential for these animals. Evidence for the requirements and necessity of others like cadmium, lead, tin, lithium and vanadium is weak (6,7).

The birds' eggs are ones of the most complex and highly differentiated reproductive cell, Germinal cell accumulates 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. 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 (8). An egg shell is the outer covering of a hard-shelled egg and some forms of eggs with soft outer coats. The generalized egg shell structure, which varies widely among species, is a protein matrix lined with mineral crystals, usually of a calcium compound such as calcium carbonate, eggs hell is 95-97% calcium carbonate crystals. It is calcium build-up and is not made of cells. Harder eggs are more mineralized than softer eggs (9).

The objective of this study is to identify inorganic elements in eggshell of some wild birds in Baghdad city as a species classification.

Materials and Methods

Eggs collection: A total of twelve eggs of House sparrow, ten eggs of White- eared Bulbul, twenty eggs of collared dove and twenty eggs of Rock dove were collected from different regions of Baghdad city during 2011.

Chemical analysis: Eggs of all species were collected and eggs hells were separated and membranes were carefully removed. Shells were rinsed with warm distilled water (25C) several times to remove adhered albumen then shells have been dried in conventional oven at 98 C for 24 hr and powdered.

Ash, macro-elements: Calcium (Ca), Phosphorous (P) and Magnesium (Mg), micro-elements: Iron (Fe), Manganese (Mn), Zinc (Zn), Cobalt (Co), Chromium (Cr) and Lead (Pb) contents in egg shells were determined according to A.O.A.C. (10). All these measurements were done in triplicates. Ash was determined by ashing samples using muffle furnace oven at 600 C for 6 hr. All analyzed elements were done by weighing approximately 0.5 g of shell samples and digested in screw-cap bottles with concentrated high purity nitric acid. Bottles were heated for 6 hr and opened several times to release CO_2 buildup, digested samples were diluted to 100 ml using distilled water.

Macro-elements: Ca, P and Mg were determined using colorimetric methods using spectrophotometer (LKB Ultra spectronic). K and B concentrations were determined by automatic flame photometer PGI 2000.

Micro-elements contents (Fe, Mn, Co, Cr and Pb) of the egg shell were determined by an atomic absorption technique using GCC-390 Flame Atomic Absorption Spectrophotometer, where these measurements were done in the Department of Chemistry, College of Science, and University of Baghdad.

Statistical analysis: Data were analyzed by using the General Linear Model Procedure of SAS (11). Means were compared by the Duncan's Multiple Range test at 5% probability (12).

Results

Fig. 1 shows that ash contents in eggshell of some wild birds in Baghdad were differed due to the bird species, Collared dove and Rock dove have the high percentage of ash content in there eggshells which were1.79 and 1.78 % respectively, whereas House Sparrow, White-eared Bulbul have the lowest percentage of ash content in there eggshells which were 1.73 and 1.72 % respectively.

Inorganic elements detected in eggshells of all bird species included primarily Ca, P, Mg, Fe, K, Mn, B, Zn, Co, Cr and Pb (Table 1 and 2). Cobalt (Co) was found in eggshells of all birds under study but in low percentage (lower than 1 ppm). However, Lead (Pb) also was found above detection limits in eggshells of all birds under study (lower than 0.5 ppm).

Table (1) showed that Ca percentage was the highest percentage among the other elements which were 97.3, 97.4, 97.8 and 97.8 % for House Sparrow, White- eared Bulbul, Collared dove and Rock dove respectively, whereas P and Mg were between 0.85 and 0.89 % for all birds under study.

Table (2) appeared that Shells of House Sparrow eggs were high in Cr (3.76 ppm) and at the same time White- eared Bulbul were high in K (6.24 ppm), Collared Dove and Rock Dove were also high in Fe (7.88 and 7.98 ppm), Mn (4.72 and 4.75 ppm), B (2.59 and 2.70 ppm). No differences were found in percentage of Co and Pb in egg shell of all birds under study which were low (lower than 0.5 ppm).

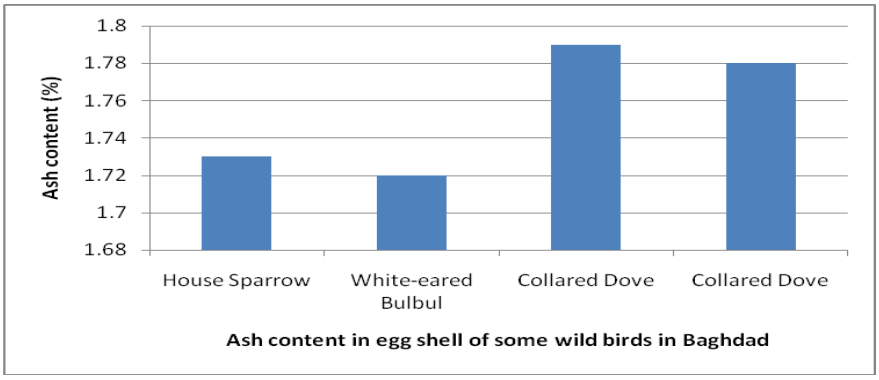

Fig. 1: Ash content in eggshell of some wild birds in Baghdad.

Table 1: Macro-elements content in eggshell of some wild birds in Baghdad (%).

Macro-elements (%)	House Sparrow	White- eared Bulbul	Collared Dove	Rock Dove
Calcium (Ca)	97.3 ±0.85^{b}	97.4 ±0.84^{b}	97.8 ±0.86^{a}	97.8 ±0.86^{a}
Phosphorous (P)	0.85 ±0.05^{b}	0.85 ±0.05^{b}	0.89 ±0.04^{a}	0.88 ±0.05^{a}
Magnesium (Mg)	0.88 ±0.03^{a}	0.88 ±0.06^{a}	0.86 ±0.04^{b}	0.85 ±0.05^{b}

Values are expressed as mean ± SE, n=3 replicates, small letters denotes differences between bird species.

Table 2: Micro-elements content in eggshell of some wild birds in Baghdad (ppm).

Micro-elements (ppm)	**House Sparrow**	**White- eared Bulbul**	**Collared Dove**	**Rock Dove**
Iron (Fe)	**7.23 ±0.74^{b}**	**7.24 ±0.78^{b}**	**7.88 ±0.77^{a}**	**7.98 ±0.76^{a}**
Potassium (K)	**5.23 ±0.68^{b}**	**6.24 ±0.70^{a}**	**5.88 ±0.71^{b}**	**5.98 ±0.68^{b}**
Manganese (Mn)	**4.23 ±0.64^{b}**	**4.27 ±0.67^{b}**	**4.72 ±0.64^{a}**	**4.75 ±0.66^{a}**
Boron (B)	**2.15 ±0.35^{b}**	**2.11 ±0.34^{b}**	**2.59 ±0.34^{a}**	**2.70 ±0.34^{a}**
Zinc (Zn)	**10.82 ±0.81^{a}**	**10.76 ±0.84^{a}**	**10.21 ±0.83^{b}**	**10.24±0.83^{b}**
Cobalt (Co)	**0.89 ±0.09^{a}**	**0.94 ±0.09^{a}**	**0.88 ±0.08^{a}**	**0.83 ±0.09^{a}**
Chromium (Cr)	**3.76 ±0.39^{a}**	**2.33 ±0.42^{b}**	**2.69 ±0.38^{b}**	**2.67 ±0.41^{b}**
Lead (Pb)	**0.41 ±0.02^{a}**	**0.44 ±0.04^{a}**	**0.42 ±0.02^{a}**	**0.40 ±0.03^{a}**

Values are expressed as mean ± SE, n=3 replicates, small letters denotes differences between bird species.

Discussion

House Sparrow (*Passer domesticus*) is actually a member of the birds of Iraq (13) belong to the weaver family, a large group of Old World birds. House sparrows have spread from Eurasia, and can now be found living with humankind around the globe and very common in human-made habitats. (14,15,16). White-eared Bulbul (*Pycnonotus leucotis*) is a member of the bulbul family. It is found in Iraq and on the Arabian peninsula nesting on the trees (17). Collared Dove (*Streptopelia decaocto*) and Laughing doves (*Streptopelia senegalensis*) are actually members 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 (13,15). These four species of birds are differed in there genetics, habitats and feeding, so they would have different amounts of minerals in there eggshell, this will agreement with Miguel (18) who founded that large differences in the levels of Fe, Se, Cu, Cr, and Sr in the chicken eggshell indicated a strong influence of feed and environment. House Sparrow had high percentage of Cr in eggshell because of eating bakery feed which are yeast fermented human food and rich in Cr (19), White-eared Bulbul had high percentage of K in eggshell because of eating high amount of fruits which are rich in K (20,21,22).

An eggshell is the outer covering of a hard-shelled egg and of some forms of eggs with soft outer coats. The generalized eggshell structure, which varies widely among species, is a protein matrix lined with mineral crystals, usually of a calcium compound such as calcium carbonate, eggshell is 95-97% calcium carbonate crystals (9). It is calcium build-up and is not made of cells. Harder eggs are more mineralized than softer eggs (8). Trace minerals deposited in shells such as zinc, copper, iron, manganese, selenium, and iodine, are essential nutrients required in small amounts for egg hardness and normal growth and development of the avian embryo (23,24). Conversely, excessive amounts of trace minerals, especially those that are acutely toxic (Co and Pb), can be equally detrimental to the developing embryo. There have been a number of reports describing selective embryotoxic and teratogenic effects of injecting trace mineral solutions into chicken eggs early in development (25, 26, and 27).

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