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

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ABSTRACT

The object of this study was to identification of inorganic elements in egg shell of some wild birds included 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 analysis for ash, macro-elements and micro- elements included Ca, P, Mg, Fe, K, Mn, B, Zn, Co, Cr and Pb. Results obtained revealed that ash percentage were high in egg shell of all studied birds which were 1.73, 1.72, 1.79 and 1.78 % for House Sparrow, White- eared Bulbul, Collared Dove and Rock Dove respectively, Ca percentage was the highest percentage among the other elements which were 97.3, 97.4, 97.8 and 97.8 % respectively, whenas P and Mg were between 0.85 and 0.89 %. Shells of House Sparrow eggs were high in Cr, in the same time the shells of White- eared Bulbul eggs were high in K, Collared dove and Rock dove were high in Fe, Mn and B. Percentage of Pb in egg shell of all studied birds were low.

Key words: Inorganic elements, Egg shell, Wild birds, Baghdad.

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 to 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 requirements and essentialness of others like cadmium, lead, tin, lithium and vanadium is weak [6,7].

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. 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 of 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, eggshell 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].

Heavy metals occur naturally in the ecosystem with large variations in concentrations. In modern times, anthropogenic sources of heavy metals, i.e. pollutions from the activities of humans, have introduced some of these heavy metals into the ecosystem. The presence of heavy metals in the environment is of great ecological significance due to their toxicity at certain concentrations, translocation through food chains and non biodegradability which is responsible for their accumulation in the biosphere [10,11].

The objective of this study was to identified inorganic elements in egg shell of some wild birds in Baghdad city as a species characteristics and pollution aspects.

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 eggshells were separated and carefully removed membranes from it, shells were rinsed with warm distilled water several time to remove adhered albumen then shells 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. [12], all these measurements were done in triplicates. Ash 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 shells sample 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.

Ca and Mg determinations were done by add 10 ml of the sample solution into a 25 ml conical flask. Prepare a 0.005 mol L^{-1} EDTA solution by diluting the 0.05 mol L^{-1} EDTA solution by a factor of 1/10. Add 20mL of this diluted EDTA to the sample solution. Add 10 ml of the ammonia buffer and 1 mL of Eriochrome Black T indicator solution. Prepare a 0.0025 mol L−1 magnesium chloride solution by diluting the 0.025 mol L^{-1} magnesium chloride solution by a factor of 1/10. Titrate the sample solution with this 0.0025 mol L^{-1} magnesium chloride solution until a permanent pink color appears. Repeat the titration with further samples until concordant results (titres agreeing within 0.1 ml) are obtained. Calculate the total moles of EDTA added to the sample solution. Calculate the moles of the magnesium chloride solution used in the back titration from your concordant results. From the equation of the titration below, the moles of Mg^{2+} will be equivalent to the moles of excess EDTA. Given the ratio of Ca^{2+} and Mg^{2+} : EDTA = 1 : 1, calculation the moles of Ca2+ and Mg^{2+} that must have been complexed with EDTA by subtracting the excess EDTA from the total moles of EDTA added to the sample. This result is the moles of Ca2+ and Mg^{2+} in the sample solution.

K and B were determined by automatic flame photometer PGI 2000, which give the concentration in ppm. Other micro-elements contents of the egg shell were determined by atomic absorption technique, using GCC-390 Flame Atomic Absorption Spectrophotometer, these measurements were done in the Department of Chemistry, College of Science, University of Baghdad.

Statistical analysis: Data were analyzed by using the General Linear Model Procedure of SAS [13]. Means were compared by the Duncan's Multiple Range test at 5% probability [14].

RESULTS

Fig. 1 showed that ash content in egg shell of some wild birds in Baghdad were differed due to bird species, Collared dove and Rock dove have the high percentage of ash content in there egg shells which were1.79 and 1.78

% respectively, whenas House Sparrow, White- eared Bulbul have the low percentage of ash content in there egg shells which were 1.73 and 1.72 % respectively.

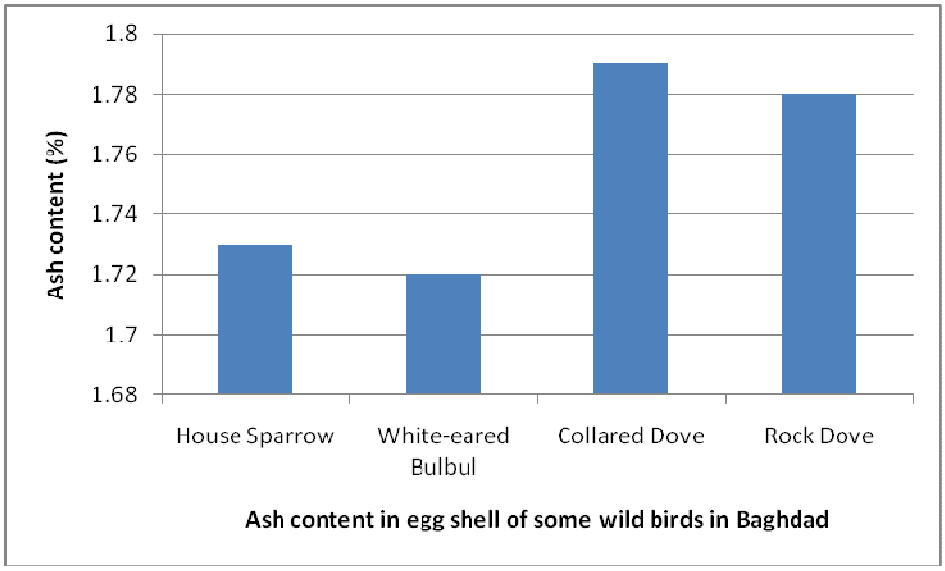

Fig. 1: Ash content in egg shell of some wild birds in Baghdad.

Inorganic elements detected in eggshell 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 studied birds but in low percentage (lower than 1 ppm). However, Lead (Pb) also was found above detection limits in eggshells of all studied birds (lower than 0.5 ppm).

Table (1) appeared that Ca percentage were 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, whenas P and Mg were between 0.85 and 0.89 % for all studied birds.

Table (2) appeared that Shells of House Sparrow eggs were high in Cr (3.76 ppm) in the same time White- eared Bulbul were high in K (6.24 ppm), Collared Dove and Rock Dove were 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 appeared in percentage of Co and Pb in eggshell of all studied birds which were low (lower than 0.5 ppm).

Table 1: Macro-elements content in egg shell 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}

Table 2: Micro-elements content in egg shell 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}

DISCUSSION

House Sparrow (*Passer domesticus*) is actually a member of the birds of Iraq [15] 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. [16,17]. 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 [18]. Collared Dove (*Streptopelia decaocto*) and Rock doves (*Columba livia*) 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 [15,19,20]. 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 [21] 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 [22], White-eared Bulbul had high percentage of K in egg shell because of eating high amount of fruits which are rich in K [23,24,25].

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, egg shell 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 [26,27]. Heavy metals like iron, tin, copper, manganese and vanadium occur naturally in the environment and could serve as plant nutrients depending on their concentrations. Mercury, lead, cadmium, silver, chromium and many others that are indirectly distributed as a result of human activities could be very toxic even at low concentrations. These metals are non-biodegradable and can undergo global ecological circles [28,29]. 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 [30,31,32]. Worldwide, the most important sources of metal pollution are mine tailings, smelter emissions, waste incineration and atmospheric deposition. But the main contribution to the trace-element load in urban top soils and dust is almost unanimously considered to be traffic emissions derived from atmospheric deposition [33,34].

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