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Determination of some Macroelements (Sodium, Potassium, Calcium, Magnesium and Phosphorus) in some Selected Eggs (Chicken, Duck, Quail, Pigeon, Guinea Fowl and Turkey) in Sokoto Metropolis

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Abstract

Egg consumption is a popular choice for good nutrients which there are varieties including, chicken, duck, quail, pigeon, guinea fowl among others. Egg is an ideal carrier for enriching human diets with some important dietary minerals. It has benefits in the reduction of health problems and influence on longevity of consumers. It is a standard for nutritional composition in many respects. There is a concern that the eggs can accumulate elements above required level as a result of interaction with the environment. However, data in Sokoto is scarce. Thus, this paper determined the levels of Na, K, Ca, Mg and P in some selected eggs of duck, chicken, quail, pigeon, guinea fowl, and turkey. Na and K were determined using flame photometry, Ca and Mg were determined by EDTA titration. Whereas, P was determined by Iroug method. Sodium (Na) concentration was in the order of decreasing trend, quail (1600±0.3) >pigeon (1600±0.3)> chicken (1597±0.6)> turkey (267±0.5)> duck (192.5±0.29).Potassium (K) concentration was in the order of decreasing trend , pigeon (3182.5±0.08)> chicken (2050±0.6)> guinea fowl (1375±0.6)> quail (1325±0.6)> duck (1600±0.6)> turkey (0.600±0.006).Calcium revealed, quail (1.15± 0.006)> duck (1.00±0.003)> chicken and guinea fowl (0.90±0.003each)> turkey (0.62±0.006)> pigeon (0.53±0.006). Magnesium (Mg) shows a trend of Guinea fowl (1.60±0.006)> quail (1.40±0.006)> chicken (1.35±0.00)> pigeon (1.05±0.006)> duck (0.80±0.006). This work unveiled high levels of Na, K, Ca, Mg and P in the selected eggs. P concentration revealed this order, turkey (9.0120+.006) > quail (8.6900±0.006)> pigeon (8.5850±0.06)> duck (8.2000±0.006)> guinea fowl (8.2000±0.006)>chicken (1.6000±0.006).Despite that, the levels are safe, except K concentration in pigeon whole egg which exceeds safe level .More studies are needed, and people with macroelement deficiencies are advised to take eggs.

1. Introduction

Eggs can make significant contribution to humans healthy diet, an average egg gives 78kcals, 6.5g protein, 5.8g fat, vitamins, trace elements, choline , aminoacids, among others[1, 2, 3].The biological system of human need for nutrition a highly complex mixture of chemical substances, namely aminoacids , proteins, carbohydrates, certain lipids , a great variety of minerals ,vitamins and water .The whole egg has been used as a standard in nutritional aspects. It is a source of many useful food substances including the macroelements [4]. The whole egg contains three distinct parts

: egg shell, white and yolk , containing varied levels of nutrients. That is why egg from several sources like chicken, duck, pigeon, guinea fowl, goose, quail, etc is utilized as food supplement to tap for nutrients even by the poor people [4,5].

Elements in both free and unfree state and a variety of chemical components are compositions of cells and tissues in humans. They are building blocks and most important to catalysts for several biochemical reactions. They are indispensable participants in the processes of growth, development, metabolism, adaptation and changing environment. Invariably, physiological and anatomical role of elements is perfectly played only if there is optimum concentration [6]. Low or high concentration can pose a problem to the body. Macroelements, for example Na, K, Ca, Mg, P are the ones whose concentrations in the body exceeds 0.01% .The absolute body composition of these elements in an average human is between a few grams to fourty kilograms due to their leading role in function of tissues ,organs , and the physiology of whole [7].

Different variety of eggs are consumed by people for various reasons, including therapeutic purposes. There is also a concern of possible accumulation of elements from the environmental pollution. The data revealing the elemental composition of our local diets including eggs is scarce in Nigeria, let alone in Sokoto State [5,8,9,] . Thus, this paper investigated the macroelements (Na, K, Ca, Mg and P) among eggs of (pigeon, duck, quail, chicken, guinea fowl) birds in Sokoto Metropolis, Sokoto State, Nigeria.

2. Methodology

2.1 Sample collection and preparation

The various eggs of chicken, duck, guinea fowl, pigeon, and quail were bought from Sokoto central market and Gwadabawa local government area, Sokoto State, Nigeria. The yolk, white and whole egg components were separated in clearly labelled containers according to methods reported by Friday *et al* [4]. Then each sample was ashed according to method reported by Bello and Abdu (2011) [10].

2.2 Elemental determination

Na and K were determined using flame photometry according to Uriyo and Singh (1974) [11]. Ca and Mg were determined by EDTA titration as suggested by [12]. Whereas, P was determined by Iroug method as reported by Bello and Abdu (2011) [10].

2.3 Statsitical analysis

Data was analyzed in SPSS at $P < 0.05$ statistically significant difference.

3. Results and Discussion

Table 1 shoes the result of sodium and potassium concentrations in selected eggs.

Table 1: Result of sodium and potassium concentrations in selected eggs in Sokoto Metropolis

Mineral element(mg/l)	Na			K		
Egg component	1.52+0.6	Yolk	Whole egg	White	Yolk	Whole egg
Chicken	1.525±0.6	2.50±0.3	1597±0.6	1.500+0.6	550+0.3	2050+0.6
Guinea fowl	500±0.6	12.0±0.6	620.0±0.6	750.0+0.6	625+0.6	1375+0.6
Quail	220±0.08	87.5+0.6	3075.0±0.6	825.0+0.6	50.0+08	1325+0.6
Pigeon	117±0.08	42.5±0.3	1600±0.3	2350+0.6	832+0.08	3182.5+0.08
Turkey	130±0.3	137.0±0.3	267.0±0.5	1282+0.14	265.6+0.5	0.600+0.006
Duck	132±0.29	600±1.16	192.5±0.29	1075+0.6	525+1.2	1600+0.6

Values are expressed as mean ±standard deviation

Table 2: Result of calcium and magnesium concentrations in selected eggs in Sokoto Metropolis

Mineral elements (mg/l)	Ca			Mg		
Egg component	White	Yolk	Whole egg	White	Yolk	Whole egg
Chicken	0.550±0.006	0.350±0.006	0.90±0.006	0.600±0.006	0.700±0.006	1.35±0.006
Guinea fowl	0.450±0.006	0.450±0.006	0.90±0.006	4.300±0.006	0.650±0.006	1.60±0.006
Quail	0.400±0.006	0.750±0.006	1.15±0.006	0.800±0.006	0.800±0.006	1.40±0.006
Pigeon	0.315±0.009	0.2153±0.006	0.53±0.006	0.365±0.006	0.365±0.006	1.05±0.006
Turkey	0.435±0.01	0185±0.006	0.62±0.006	0.465±0.006	0.785±0.006	1.25±0.006
Duck	0.550±0.006	0.450±0.006	1.00±0.03	0.450±0.006	0.350±0.006	0.80±0.006

Values are expressed as mean +standard deviation

Table 3: Result of phosphorus concentration in selected eggs in Sokoto Metropolis

Mineral element(mg/l)	P		
Egg component	White	Yolk	Whole egg
Chicken	0.950+0.006	0.650+0.006	1.6000+0.006
Guinea fowl	4.320+0.006	3.880+0.006	8.2000+0.006
Quail	4.320+0.006	4.370+0.006	8.6900+0.006
Pigeon	4.600+0.006	3.980+0.006	8.5850+0.006
Turkey	4.284+0.006	4.728+0.006	9.0120+0.006
Duck	3.705+0.006	4.820+0.006	8.5209+0.006

Values are expressed as mean +standard deviation

Eggs are typical inexpensive high-quality sources of proteins, vitamins, and minerals required for healthy diet and life. Global consumption has tripled in the past 40years. This is happening amidst of a time when food insecurity is a brewing public health crisis especially in the poor regions of the world like Africa. A typical egg composed of shell, yolk and, white. Each of these contributes his own parcel of nutrients compositions. Invariably, egg is highly nutritious. One of the various nutrients in egg are the mineral elements (Na, K, Ca, Mg, and P), which are very vital in the functioning of biological system [3,13]. Being egg nutritious (contains vitamins A, D, E, K, 9 aminoacids, fatty acids, cholesterol, antioxidants, antibodies, elements, etc) global increase in demand of food security, numerous people use various avian eggs in their diets as nutritional supplements. Thus, there is need for awareness about different egg constituents' levels to ensure safety and to guide policy making, decision making and interventions; these could only be attained upon analyzing specific components of eggs [3,14]. That is why macroelements were determined in this study. Moreover, studies which analyzed mineral elements in eggs or local foods are scanty [15].

The result of this study was shown in Tables 1, 2, and 3. Sodium (Na) concentration was in the order of decreasing trend ,quail (1600±0.3) >pigeon (1600±0.3)> chicken(1597±0.6)> turkey (267±0.5)> duck (192.5±0.29).Potassium (K) concentration was in the order of decreasing trend , pigeon (3182.5±0.08)> chicken (2050±0.6)> guinea fowl (1375±0.6)> quail (1325±0.6)> duck (1600±0.6)> turkey (0.600±0.006).

Na and K are most abundant intracellular and extracellular cations known in the body. They are involved in the transmission of nerve impulses and regulations of osmotic pressure [16]. K is also needed for activation of many enzymes. Low K intake is associated with a risk of high blood pressure, arthritis, cancer, stroke, infertility and gastrointestinal disorders [15].

Calcium (Ca) concentration revealed, quail (1.15± 0.006)> duck (1.00±0.003)> chicken and guinea fowl (0.90±0.003each)> turkey (0.62±0.006)> pigeon (0.53±0.006). Sparingly soluble calcium compounds act as bearings in skeleton. Ca is essential in blood clotting, muscle contraction ,transmission, bone and tooth formation. Excess intake can cause soft tissue, constipation, kidney stones, hypocalcaemia, and prostate cancer [16,17,18]. Magnesium (Mg) concentration show a trend of guinea fowl (1.60±0.006)> quail (1.40±0.006)> chicken (1.35±0.00)> pigeon (1.05±0.006)> duck (0.80±0.006). Mg acts as cofactor of many enzymes (dieter, 2008).

P concentration show a trend of concentration in this order, turkey (9.0120+.006)>quail (8.6900±0.006)> pigeon (8.5850±0.06)>duck (8.2000±0.006)> guinea fowl (8.2000±0.006)>chicken (1.6000±0.006). P has many uses in the body. It acts as buffer in plasma, it is used to detect pH, and it served in bone and tooth enamel. Phosphorus add phosphate group to many compounds and intermediates to prevent them from escaping membranes of cells or organelles. Phosphorylation is also essential in regulation and control of enzymes. P serve in phospholipids, DNA, and RNA. Pyrophosphates acts as best energy store in the body . Side effects of excess P intake includes malarbsoption of calcium, and skeletal porosity[7].

By comparing the six avian eggs, results show that some level of disparities exist in the concentration of Na, K, Ca, Mg and P. Disparity of elements among avian eggs was reported by many [2,4,8]. K is the highest element present in the examined whole eggs, then Na. This is perhaps because the duo are the most abundant extracellular and intracellular cations in humans [16]. The element following Na and K was the P, and this may not be unconnected with its vast role in the biological system. Mg and Ca were the least, but they still displayed significant concentrations. This may be because they are indispensable macromolecules in the body. Macromolecules are required in grams to kilograms by the body, thus all macroelements have to be significant. It is not unusual to see a food that gives high concentrations of macroelements. Moreover, it further unveils the so-called name of egg as a standard food and claims that egg contains many nutrients [19].

[9,17,18] reports, Recommended Dietary Allowances (RDA), Adequate Intake (AI), and Tolerable Upper Intake (UL) to guide the public on the levels of elements they need to take to avail public health. Thus we compared the findings of this study with the levels reported by[9,17,18] ; we found that, Ca, Mg, and P in all the analyzed whole eggs were below the RDA , AI, and UL levels at all age stages .They are probably not harmful .There is no data of RDA , AI, and UL ,pertaining Na and K ,but there is Dietary Goal for Preventing Lifestyle Disease (DG) .The results of Na and K were below DG except in K concentration from pigeon (3182±0.008 mg/l) . This study recommends that people with macronutrients deficiencies should use egg to supplement their diets.

4. Conclusion

This study concluded that the studied avian eggs contains significant and safe levels of Na, K, Ca, Mg and P; except pigeon egg which revealed high K content above the DG.

References

[1] American Council on Science and Health (2002). The role of eggs in the diet: update. ACSH Inc.: New York.
[2] Bertechini, A.G. and Mazzuco, H. (2013). The table egg: A review. *Ciencia Agrotecnologia*, 37(2):115-122.
[3] Zaheer, K. (2015). An updated and review on chicken eggs: Production, consumption, management, aspects and nutritional benefits to human health.Www.scribd.com.
[4] Friday, T.E., James, O., Eniola, J.O., Baku, B.A. (2011). Variations in micro nutrients content and lipid profile of some avian eggs. American Journal of *Experimental Agriculture*, 1(4): 343-352.
[5] Salwa, A. (2016). Determination of some trace elements in chicken eggs from different sources. *Journal of Pharmacognosy and Phytochemistry* ,5(5): 417-420.
[6] Dusora, H., Travnicek, J, Reksa,Z., Falta,D., Palkav, (2012). Trace elements content in market eggs in Bohemia. Acta Universitatis Agriculture Et Silviculturae Medelianae Brunonsus, LX,6:75-80.
[7] Skalnaya, G.M. and Skalny, V.S. (2018). Essential trace elements in human health: A physicians view.Tomsk Publishing House of Tomsk University: Tomsk.
[8] Salwa, A. A. and Shuhaimi-Othman, M. (2011). Metals concentrations in eggs of domestic avian and estimation of health risks from eggs consumption. *Journal of Biological Sciences*,11(7):448-453.
[9] Yoshida, M., Ogi, N.I., Washita, Y. (2011). Estimation of mineral and trace elements intake in vegans living in Japan by chemical analysis of duplicate diets. Health, 3(11): 672-676.
[10] Bello, A.G. And Abdu, I. (2011). Nutrient and Mineral elements levels in four indigenous tree seeds in Sokoto State, Nigeria. *Journal of Plant Breeding and Crop Sciences*, 3(5): 396-400.
[11] Uriyo,A.P. and Singh, B.R. (1974). Practical soil chemistry manual. Department of soil science and Agricultural Chemistry, University of Daressalam, Motogo (unpublished).
[12] Al-Obaidi, A.F. Mehdi, IB., Shadeedi, M.S. (2012). Identification of organic elements in egg shell of some wild birds in Baghdad. *Advances in Applied Science Research*, 3(3): 1454-1458.
[13] Ruxton, CHS., Derbyshire, E., Gibson, S(2016). The nutritional properties and health benefits of eggs. Nutrition *and Food Science*, 40(3):263-279.
[14] Egg Nutrition Centre (n.d.). The yolk; a nutrient goldmine.www.egg nutrient centre.org
[15] Tunsaringkarn, T., Tungjaroechai, W., Siriwong, W. (2013). Nutrient benefits of Quill eggs. International *Journal of Scientific and Research Publications*, 3(5):1-8.
[16] Dieter,R.(2008). Introduction to bioinorganic chemistry. A lecture notes University of Lunds.
[17] Comptroller General of the United States (1978). Recommended dietary allowances: more research and better food guides needed.Www.gao.gov.
[18] Food and Nutrition Board, Institute of Medicine, National Academies (1997). Dietary reference intakes: elements. www.nap.edu.
[19] Sarkingobir, Y. (2012). Determination of some mineral elements in some selected eggs (2012). BSc thesis submitted to Department of Biochemistry, Usmanu Danfodiyo University, Sokoto,Nigeria (unpublished).