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CHEMICAL CHARACTERISTICS OF WHOLE EGGS FROM AVIAN SPECIES: A COMPARATIVE STUDY

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ABSTRACT

Egg weight and egg component, chemical composition, fatty acids and cholesterol, amino acids and minerals content in conventional eggs (ostrich, duck, hen and quail) were studied. Results indicated that, the ostrich egg had highest egg weight (g), and so had highest percent of weight and shell, while duck eggs showed highest percent of yolk. For chemical composition, Ostrich egg have had more highest moisture, carbohydrates and cholesterol contents, while highest values of protein, lipid and total ash were obtained by duck egg (at wet weight basis). Oleic, palmitic, linoleic, stearic and palmitoleic acids were the major fatty acids in egg yolk of all studied eggs. The hen egg had highest oleic and stearic acid, while duck egg had highest palmitic acid. The highest linoleic acid was obtained by quail egg and the highest palmitoleic acid was found by ostrich egg. Concerning amino acids content, glutamic acid had the highest one in the protein composition followed by aspartic acid and leucine in all studied eggs. The highest values of aspartic and leucine were obtained by hen eggs, while the highest values of glutamic acid were obtained by ostrich egg. Concerning minerals content, the ostrich egg had the highest values of iron content. The duck egg had highest values of sodium, potassium and zinc content, while the highest values of magnesium and phosphorus were obtained by hen eggs. Finally the highest calcium content was obtained by quail eggs.

Keywords: ostrich, duck, hen, quail, chemical composition, fatty acids, amino acids, cholesterol, minerals.

INTRODUCTION

Eggs have a special place, being a rich source of high-quality protein that experimental nutritionists often use them as a standard for measuring the nutritional quality of other food proteins(FAO/WHO, 1973). Eggs are, also, an important source of fatty acids as well as of some minerals and vitamins (Mc Namara and Thesmar, 2005). Eggs provide a unique well-balanced source of nutrients for persons of all ages. They contribute significantly to the body's nutrient needs during rapid growth and there fore an excellent food fore young children and teens. Their high nutrient content, low caloric value and ease of digestibility make eggs valuable in many therapeutic diets for adults. Eggs are also one of the least expensive single food sources of complete protein (Kaewmanee, *et al*., 2009). A variety of eggs from different species of birds are commercially available in different parts of the world from the smallest quail egg to the very large ostrich egg. There are many species of birds adapted to a wide range of lifestyle and habitats throughout the world, consuming a very diverse range of diets (Speake, *et al*., 1999). Duck, hen and smaller eggs such as quail eggs as well as the largest bird eggs from ostrich are occasionally used as a gourment ingredient.

The eggs origins from other species, if consumed tend to be a specialist product sold in exclusive restaurants or stores. While there is a very wide knowledge concerning the composition of eggs obtained from studies on the hen eggs, as such eggs are easily available, but data for other bird eggs are rare. The aim of this research was to comparatively examine for the egg weight and egg components, chemical composition, cholesterol and fatty acids composition, amino acids composition and some minerals content of ostrich, duck, hen and quail eggs. The research data may lead to a better comparison of the relative differences of the components of the various eggs.

MATERIALS AND METHODS

Materials:

Eggs with non-cracked clean shells were selected on the day of lay from each Ostrich (*Struthio camelus L.,*), Duck (*Anas platyrhucus*), Hen (Lohman selected leghorn [LSL]) and quail (*Coturinx coturinx japonica*) were collected from poultry breeding farm, faculty of Agriculture, Al-Azhar University, Cairo.

Methods:

Egg weight and egg components:-

Individual weight of eggs was recorded to nearest hundred gram. Yolk weight and shell weight with adhering membranes of each egg were also weighted. Albumen weight was calculated by subtracting yolk and shell weight from whole egg weight. Yolk, albumen and shell percentages were calculated.

Chemical analysis:-

Moisture content, crude protein (N.6.25), crude fat and ash content (550 ^{o}C) were determined according to the methods of AOAC (2000). Carbohydrates content was calculated by difference.

Determination of cholesterol:-

The rapid technique for extraction of egg cholesterol modified by Washburn and Nix (1974) was followed using chloroform: methanol solvent (2:1). Total cholesterol content was determined according to the method described by Conrchaine et al., (1959) by measuring the absorbance of developed purple color at 560 nm against a blank reagent using spekoll 11 spectrophotometers (carl zeiss JE NA).The results were calculated as mg/gm yolk.

Determination of fatty acids:-

Preparation of fatty acids methyl esters:-

Fatty acids methyl esters were done according to Stahl (1967). The methyl esters of fatty acids were prepared using benzene: methanol: concentration sulfuric acid (10: 86: 4 by volume) and metheylation was carried out for one hour at 80-90 ^{o}C.

Identification of the fatty acid methyl esters by gas liquid chromatograph (GLC):-

A Hewlett Packard GLC (model 5890) equipped with a flame ionization detector and coiled glass column (1.8m x 2 mm ID) packed 10% Diethylene glycol succinate (DEGS) and supported on chromosorb W- HB 100- 120mesh was used. The samples (1µL) were injected into the column using a hamilton micro syringe. The gas chromatographic conditions followed for temperature programming analysis were:-

Temperature of column 80- 170 ^{o}C, rate heating 5 ^{o}C / min, detector 300 ^{o}C and injector 250 ^{o}C: flow rates: Hydrogen 33 ml/ min, Nitrogen 30 ml/ min and Air 330 ml/ min. peak areas were measured using a Hewlett Packard Integrator model 3392A.

Amino acids determination:-

Amino acids were determination in dried, fat free samples by ion-exchange chromatography of the acid hydrolyzed protein. Samples were hydrolyzed with 6 N HCl in a sealed tube for 32 hr in oil bath at 110 ^{o}C. A Beckman amino acid analyzer (Model 6300) was used for separating amino acids using sodium citrate buffer as described by sales and Hayes (1996).

Determination of minerals:-

A dry ashaing procedure was used to prepare the samples for mineral analysis. Sodium, potassium, calcium, magnesium, iron and zenc were determined according to AOAC (2000) by using Unicam 929 Atomic Absorption Spectrometers. Phosphorus was determined by photometric method as described in AOAC (2000) using unicam sp 1800 spectrophotometer at wave length 400nm against molybdovandata reagent.

RESULTS AND DISCUSSION

Egg weight and egg components :-

Table (1) shows the average values of egg weight and egg components of fresh eggs of ostrich, duck, hen and quail. It can be easily observed that ostrich's egg posses remarkably highest value of weight. In contrast quail's egg had lowest value of weight. The values of eggs weight were 1350, 72, 60 and 11.75 g for ostrich, duck, hen and quail respectively.

Regarding egg components, the values (g) for white, yolk and shell for the same strains are 810, 280, 260; 37, 25, 10; 36, 18, 6 and 6.8, 3.7, 1.25 respectively. Both kinds of ostrich and hen egg's exerted obvious higher white percentage (60 %) than quail (57.90 %) and duck (51.40 %). On the other hand ostrich eggs contained less yolk percent and the highest value was obtained for duck eggs. The values of yolk percent were 20.7, 34.7, 30 and 31.5 % for ostrich, duck, hen and quail respectively. The highest value for shell percent was obtained by ostrich (19.3 %) followed by duck (13.9 %) while, lower values for shell percent were 10 and 10.6 % were observed to hen and quail eggs respectively. This finding was coincided with Sharaf (1996) and Sugino *et al.* (1996). Brand *et al.* (2003) found that the highest ostrich egg weight (1446 g). Generally, the proportion of egg components are

dependent on the strain, breeding, egg size, age and season (Sugino et al., 1996).

Table (1): Egg weight (g) and egg components (%) of various raw eggs.

parameter	Egg weight (g)	Egg component					
		White		Yolk		Shell	
		weight (g)	%	weight (g)	%	weight (g)	%
Egg type							
Ostrich	1350	810	60.00	280	20.70	260	19.30
Duck	72	37	51.40	25.00	34.70	10.00	13.90
Hen	60	36	60.00	18.00	30.00	6.00	10.00
Quail	11.75	6.8	57.90	3.70	31.50	1.25	10.60

Proximate chemical Composition

Proximate chemical analysis of the studied eggs is represented in Table (2). Results are expressed on wet and dry weight basis. From the tabulated data, moisture is found the major component of all examined samples as it reached to 79.12, 70.81, 78.22 and 71.50 % for whole ostrich, duck, hen and quail eggs respectively. The variations in the moisture content in the samples were less than 10 %. Ostrich and hen whole eggs had higher moisture content than quail and duck. The variability in moisture content of egg is dependent on the breed, environmental condition, size of the egg and rate of production (Stadelman and Coterill, 1977).

Besides, protein and crude fat constitute the major nutritious components of the solid matter of all studied eggs. The highest values of protein content were obtained by duck eggs on wet weight basis and hen eggs on dry weight basis, while the lowest values were given by ostrich eggs. Moreover, the duck and quail whole eggs had higher crude fat content than other studied whole eggs.

Ash content was noticeable in the ostrich eggs compared to the other species at wet weight basis, while when compared at dry weight basis the hen eggs had the highest ash content among the studied species.

In contrast, the ostrich whole eggs had the highest carbohydrate level, while the lowest value was obtained by duck whole eggs.

Table (2): Chemical composition of various raw whole eggs (%).

Component	Moisture	Dry matter	Crude protein		Crude fat		Total ash		Carbohydrate		Cholesterol mg / g yolk
Eggs			**W.B**	**D.B**	**W.B**	**D.B**	**W.B**	**D.B**	**W.B**	**D.B**	
Ostrich	79.12	20.88	9.53	45.64	7.78	37.26	0.77	3.68	2.80	13.42	17.55
Duck	70.81	29.19	13.80	47.27	12.75	43.68	1.10	3.77	1.54	5.28	13.84
Hen	78.22	21.78	10.56	48.48	8.35	38.34	0.90	4.13	1.97	9.05	12.75
Quail	71.50	28.50	13.30	46.67	12.43	43.61	1.05	3.68	1.72	6.03	13.50

W.B, wet weight basis. D.B, dry weight basis.
Carbohydrate calculated by subtraction.

These results are found in general accordance with Sharaf (1996) for hen and quail eggs, Kaewmanee et al., (2009) for duck egg. However our findings did not agree with that obtained by Sinanoglou et al. (2011) for ostrich egg since they found that ostrich had higher lipids content than duck and quail egg. The differences in the proximate compositions of eggs under study could be attributed to many factors including bird species, bird growth stage and feed habits (Stadelman and Coterill, 1977).

The determination of cholesterol of egg yolk of the tested eggs was conducted and the results were expressed as mg / g yolk in Table (2) also. From the data, it can be easily seen that ostrich egg yolk had higher values of cholesterol (17.55) than other species. Generally, these results are in accordance with Sinanoglou et al. (2011). Much higher compared to the value reported for ostrich (13 mg / g) (Horbanczuk, et al., 2003). It can be observed from the table, that quail's egg yolk contained higher cholesterol than hen's egg yolk and similar trend was observed by Sharaf, (1996). Quail eggs contained lower cholesterol than those reported by Maurice et al. (1994) and higher than reported by Bitman and Wood (1980). Duck eggs have aslightly higher cholesterol than hen eggs. Similar data were obtained by Jalaludeen and Churchil (2006). However, egg yolk cholesterol levels of domestic fowls are influenced by species, breed, strain, age, accuracy of the used analytical methods and variation in assays condition (Stadelman and Coterill, 1977).

Fatty acids profile:-

The crude fat content of egg white is negligible, so fatty acids composition of egg yolk of tested eggs were studied employing gas liquid chromatography (GLC) technique. Data of distribution of the various identified fatty acids are expressed as percentage of each fatty acid of total acids (Table 3).

Table (3): Fatty acids profiles (%) in crude fat of various raw egg yolks.

Fatty acid	Egg type			
	ostrich	Duck	Hen	Quail
C : 8 : 0	-	-	0.41	0.08
C : 10 : 0	0.06	0.25	0.22	0.12
C : 14 : 0	0.65	0.86	0.12	0.58
C : 15 : 0	0.12	0.10	0.47	0.09
C : 16 : 0	32.75	33.67	28.18	31.61
C : 16 : 1	8.40	3.95	4.94	4.51
C : 17 : 0	0.22	0.18	0.20	0.23
C : 17 : 1	0.12	0.09	0.21	0.08
C : 18 : 0	6.53	3.82	10.51	7.38
C : 18 : 1	40.47	44.96	45.15	43.45
C : 18 : 2	7.90	8.32	7.47	8.87
C : 18 : 3	0.70	0.77	0.56	0.40
C : 20 : 0	0.05	0.25	0.19	0.08
C : 20 : 1	0.32	0.28	0.22	0.12
C : 20 : 2	1.71	2.50	1.15	2.40
Total fatty acids	100.00	100.00	100.00	100.00
Saturated Fatty acids	40.38	39.13	40.30	40.17
Unsaturated fatty acids	59.62	60.87	59.70	59.83
Mono unsaturated fatty acids	49.31	49.28	50.52	48.16
Poly unsaturated fatty acids	10.31	11.59	9.18	11.67

Data presented in Table (3) showed that C8 : 0, C10 : 0, C14 : 0, C15: 0, C17 : 0, C17 : 1, C18 : 3, C20 : 0, C20 : 1 occurred only as minor components in Ostrich, Duck, Hen and Quail egg's yolk as each of the fatty acids represents less than 1 % of total fatty acids determined.

Regarding saturated fatty acids, palmitic (C16: 0) is considered the predominant acid followed by stearic acid (C18: 0) for all studied egg yolk. The duck egg yolk had the highest palmitic acid (33.67 %) and the lowest values were obtained by hen's egg yolk (28.18 %). Great variation was observed for second dominant saturated fatty acid (stearic acid) between different species of egg yolk. The values of stearic acid (C18 : 0) were 6.53, 3.82, 10.51 and 7.38 % for ostrich, duck, hen and quail egg yolk respectively.

Concerning unsaturated fatty acids, the oleic (C18: 1) represents the predominant unsaturated fatty acid for all tested egg yolks with percentages of 40.47, 44.96, 45.15 and 43.45 of total fatty acids content of Ostrich, Duck, Hen and Quail eggs respectively. The second dominant unsaturated fatty acid for duck, hen and quail eggs was linoleic acid (C18: 2) while for ostrich egg yolk was palmitoleic (C16: 1). Absolutely, oleic showed the highest fatty acid percentage among determined fatty acids for all tested egg types.

The same data revealed that unsaturated fatty acids content was higher than the saturated fatty acids content. This finding was exhibited by all studies on egg yolk, since saturated fatty acids represent 40.38, 39.13, 40.30 and 40.17 % of total fatty acids content, while unsaturated fatty acids content represent 59.62, 60.87, 59.70 and 59.83 % from total fatty acids content of ostrich, duck, hen and quail egg yolks respectively.

In general, the unsaturated fatty acid content of all examined egg yolks was higher than saturated fatty acid content, while monounsaturated fatty acid was higher than polyunsaturated fatty acids.

These results were generally in accordance with Sinanoglou et al. (2011) for ostrich, duck and quail eggs. Concerning fatty acids composition of hen and quail yolks the results were generally in agreement with the observation of Lall and Slinger (1973); Powrie (1973); Bitman and Wood (1980) and Sharaf (1996) for hen and quail egg yolks and Liu et al. (2011) for ostrich eggs. But, some variations for fatty acid percentages were observed by Kaewmanee et al. (2009) for duck egg, since they observed higher oleic acid content and lower palmitic acid content than the obtained results of this work.

However, the fatty acids composition of egg yolk fat is influenced by the breed, strain (Couch and Salama, 1973) and by types of fatty acid in the feed (Powrie and Nakai, 1985).

Amino acids content :-

The amino acids determination was carried out in the eggs under investigation because of their importance from nutritional point of view, especially essential amino acids. Whole eggs were used in this study, since protein is found in yolk and in the white. The obtained results are expressed as g/100g protein and are shown in Table (4).

Sixteen amino acids were detected at various quantities in all samples analyzed (ostrich, duck, hen and quail whole egg). The presence of

the sixteen amino acids in studied eggs were proved by Stadelman and Coterill (1977), Razem et al. (1989) and Panda and Singh (1990).

The data revealed that glutamic acid had the highest value in all tested eggs, since it represents about 14.48, 12.81, 14.39 and 12.78 g/100g protein for ostrich, duck, hen and quail whole eggs respectively. The next amino acid in all investigated eggs was aspartic acid as its values reached to 8.20, 8.47, 10.32 and 9.02 g/100 g protein for ostrich, duck, hen and quail eggs respectively. Leucine occupied the third highest position of all studied proteins as its values were 8.18, 7.88, 8.71 and 7.36 9.02 g/100 g protein for ostrich, duck, hen and quail eggs respectively.

From the above mentioned discussion, it could be observed that, the highest values of aspartic and leucine were obtained by hen eggs, while the highest values of glutamic acid was obtained by ostrich eggs.

On the other hand, the two amino acids methionine and histidine showed the lower contents in the protein of whole liquid egg of all investigated eggs.

In addition, it could be observed that, the hen and ostrich eggs had the highest value of total essential amino acids (39.56 and 39.11 g/100g protein), followed by duck (35.90) and the lowest value of total essential amino acids (34.40) was noticed for quail eggs. The same conclusion was obtained for nonessential amino acids.

Table (4): Amino acids composition (g /100g protein) of various raw egg yolk.

Amino acid	Egg type				FAO/WHO (1973)
	Ostrich	Duck	Hen	Quail	
Essential amino acid					
Valine	6.29	5.49	6.15	5.26	5.0
Methionine + Cyestine	1.25	1.73	2.84	1.50	3.5
Isoleucine	5.98	4.20	5.20	4.06	4.0
Leucine	8.18	7.88	8.71	7.36	7.0
Therionine	4.30	4.84	4.54	4.58	4.0
Phenyl alanine + Tryptophan	6.29	6.13	6.15	6.01	6.0
Lysine	6.82	5.63	6.06	5.63	5.5
Nonessential amino acid					
Arginine	5.77	4.63	5.68	4.58	
Histidine	2.62	2.17	2.55	2.25	
Aspartic acid	8.20	8.47	10.32	9.02	
Tyriosine	4.82	2.81	3.31	2.40	
Serine	5.45	6.72	7.10	6.31	
Glutamic acid	14.48	12.81	14.39	12.78	
Proline	7.45	5.34	5.68	4.13	
Glycine	3.67	3.40	3.40	3.60	
Alanine	5.87	5.71	5.96	5.41	
Total Essential amino acid	39.11	35.90	39.56	34.40	
Total Nonessential amino acid	58.33	51.06	58.21	50.48	

Comparing the essential amino acids content in the protein of different eggs under investigation with those of FAO/WHO (1973); it could be observed that all eggs contained the same seven essential amino acids as

the FAO/WHO reference protein. The same data showed that contents of all essential amino acids slightly higher than those of the FAO/WHO reference protein except methionine + Cyestine which had lower than FAO/WHO reference protein.

General agreement was found between the obtained results and those of Razem et al. (1989); Panda and Singh (1990) and Sharaf, (1996) for hen and quail egg and Brand et al. (2003) for ostrich egg with slight variation. Stademan and Coterill (1977) added that there are many factors affecting the concentration of nutrients in eggs including protein and amino acids such as age, breed, strain, differences in eggs produced by individual bird and environmental conditions.

Minerals content :-

The amounts of some important minerals in the studied egg types are shown in Table (5). From the obtained results, it could be observed that, the phosphorus had the highest value of all studied eggs, and these values represented 1125, 949, 1152 and 1070 mg/100g on dry weight basis for ostrich, duck, hen and quail whole eggs respectively, While potassium occupied the second order were showed 584, 788, 739 and 474 mg/100g. Sodium comes at the third order in all studied eggs. On the other hand, iron was considered to be the most important minor mineral in eggs. The iron contents were 12.93, 8.56, 6.88 and 6.66 mg/100g for ostrich, duck, hen and quail eggs respectively.

Table (5): Minerals content (mg /100g on wet and dry weight basis) of various raw whole eggs.

Minerals	Egg type							
	Ostrich		Duck		Hen		Quail	
	W.B	D.B	W.B	D.B	W.B	D.B	W.B	D.B
Sodium (Na)	109	522	200	685	130	597	116	407
Potassium (K)	122	584	230	788	161	739	135	474
Calcium (Ca)	58	278	60	206	68	312	110	386
Magnesium (Mg)	22	105	28	96	25	115	30	105
Phosphorus (P)	235	1125	277	949	251	1152	305	1070
Iron (Fe)	2.7	12.93	2.5	8.56	1.5	6.88	1.9	6.66
Zinc (Zn)	1.4	6.70	2.4	8.22	1.5	6.88	1.9	6.66

With reference to comparison between different avian species for minerals content, it could be concluded that, the duck egg had the highest value of sodium, potassium and zinc, while quail egg had the highest value of calcium.

On the other hand ostrich whole eggs had the highest value of iron content. The highest magnesium and phosphorus content were obtained by hen eggs

General agreement was found between the obtained results and those of Sharaf (1996) for hen and quail eggs ; Mc Namare and Thesmar (2005) for hen egg. Some variation for minerals content between the obtained results and those for Brand et al. (2003) for ostrich egg and Jalaludeen and Churchil (2006) for duck egg. Stadelman et al. (1988) declared that the

amounts of these mineral in egg are known to be influenced by breed, strain, diet, age of the bird and season.

Conclusion

The results indicated that, the eggs chemical composition varied within species and might be associated with the different characteristics of the birds and their feeding habits. The important thing to note is that all avian egg types contain all essential nutrients which required by human. The research data relating the processing of some type of egg are still fragmentary and information on their nutritive value, functional properties and utilization are scarce. Therefore, more studies are needed for a better understanding of the influence of various production and processing factors on the yield and quality of eggs.

REFERENCES

AOAC (2000): Association of Official Analytical Chemists. In Official Methods of Analysis (17th Ed) Gaithersburg M D.

Bitman, J. and D. L. Wood (1980): Cholesterol and cholesterol esters of eggs from various avian species. Poultry Science. 59, 2014.

Brand, Z., T. S. Brand and C. R Brown (2003): The effect of different combinations of dietary energy and protein on the composition of ostrich eggs. South African journal of Animal Science 33 (3) 193.

Couch, H. R. and A. E. Salam (1973): Fatty acid positional distribution in egg yolk triglycerides from various avian species. Lipids, 8, 675.

Courchaine, A., W. Miller and D. Stein (1959): Determination of total and free cholesterol. Clin. Chem. 5, 609.

FAO/WHO (1973): Energy and Protein Requirements. Report of a Joint FAO/WHO Ad Hoc Expert Committee. WHO Tech. Report Series 522, FAO Nutrition Meetings Report Series, 52, Rome, Italy.

Hortbanczuk, J. J.; O R. G. Cooper, A. Jozwik, J. Kleweic, J. Krzyzewski and W. Chylinski (2003): Cholesterol content and fatty acid composition of egg yolk of grey nandu (*Rhea america*). Animal Science papers and reports 21 (4), 265.

Jalaludeen, A. and R. R. Churchil (2006): Duck eggs and their nutritive value. Poutry line 10, 35.

Kaewmanee, T.; S. Benjakul and W. visessanguan (2009): Changes in chemical composition, physical properties and microstructure of duck egg as influenced by salting. Food Chemistry 112, 560.

Lall, S. P. and S. J. Slinger (1973): Nutritional evaluation of rapeseed oil and rapeseed rootstocks'. For laying hens. Poultry Sci., 52, 1729.

Liu, X.; F. Wang, X. Liu, Y. Chen, and L. Wang (2011): Fatty acids composition and physicochemical properties of ostrich fat extracted by supercritical fluid extraction, Eur. J. Lipid Sci. Technol. 1, 1.

Maurice, D. V.; S. F. Lightsey; K. T. Hus; T. G. Gayiord and R. V. Reddy (1994): Cholesterol in eggs from different species of poultry determined by capillary GLC. Food Chemistry 50, 367.

McNamara D. J and H. S. Thesmar, (2005): Eggs. Washington Dc. USA. Egg nutrition center.

Panda, B. and R. P. Singh (1990): Developments in processing quail meat and eggs. World Poultry Science. 46, 219.

Powrie, W. D. (1973): Chemistry of egg and egg products. In egg Sci. and Technology 2 nd Edition (Stadelman and coterill) Avi publishing Co., west port, Coun., U. S. A.

Powrie, W. D. and S. Nakai (1985): Characteristics of Edible Fluids of Animal Origin: Eggs. In O. R. Fennema (Ed.) Food Chemistry (PP. 829- 855). New York: Marcel Dekker.

Razem, B. K.; D. Razem; S. Matic; V. Mihokovic; A. K. Soos and N. Milanovic (1989): Chemical and organoleptic properties of irradiated dried whole egg and egg yolk. Journal of Food Protection 52, 781.

Sales, J. and J. P. Hayes (1996): Proximate, amino acids and minerals composition of ostrich meat. Food Chemistry, 56 (2): 167.

Sharaf, A. M. (1996): Chemical, technological and nutritional studies on hens and quails eggs. M. SC. Thesis Faculty of Agriculture, Al-Azhar University.

Sinanoglou, V. J.; I. F. Strati and S. M. meimaroglou (2011): Lipid, fatty acid and caroteniod content of edible egg yolks from avian species: a comparative study – Food Chemistry 124, 971.

Speake, B. K.; P. F. Sural; R. C. Noble; J. V. Beer and A. N. R. Wood (1999): Differences in egg lipid and antioxidant composition between wild and captive pheasants and gees. Comparative Biochemistry and physiology part B. 124, 101.

Stadelman, W. J and O. J. Cotterill (1977): Egg Science and Technology. 2 nd. Ed. Avi Pub. Comp. Inc. Connecticut.

Stadelman W. J.; V. M. olson; G. A. Shemwell and S. Pasch (1988): Egg and poultry – meat processing .Ellis Horwood chichester, U. K.

Stahl, E. (1967): Editor thin layer chromatography A laboratory and Book publisged by springes verloag. Berlin, Heidelberg, New york.

Sugino, H, T.Nitoda and L. R. Juneja (1996): General chemical composition of hen eggs. In T. Yamamoto, L. R. Juneja, H. Hatta and M. Kim (Eds). Hen eggs their basic and applied science (pp. 13-24). Boca Raton: CRC press.

Washburn, A. and D. Nix (1974): A rapid technique for extraction of yolk cholesterol. Poultry Sci., 53, 118.

الخصائص الكيميائية للبيض من أنواع طيور مختلفة: دراسة مقارنة

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تم دراسة البيض الناتج من أربعة أنواع مختلفة من الطيور الشائعة الانتشار وهى النعام والبط والدجاج والسمان وذلك من ناحية كلا من وزن البيضة ووزن مكوناتها وتركيبها الكيميائى وأيضا من ناحية كلا من الأحماض الدهنية والكوليستيرول والأحماض الأمينية ومحتواها من العناصر المعدنية.

وقد أظهرت النتائج حصول النعام على أكبر وزن للبيضة وأعلى نسبة مئوية لكلا من البياض والقشرة بينما أظهر بيض البط أعلي نسبة مئوية للصفار ومن ناحية التركيب الكيميائي أظهربيض النعام أعلى القيم من ناحية الرطوبة والكربوهيدرات والكوليسترول، بينما أعطى بيض البط أعلى القيم بالنسبة للبروتين والدهون والرماد الكلى علي أساس الوزن الرطب. وفيما يتعلق بالأحماض الدهنية، سادت خمسة أحماض دهنية وهى الأوليك والبالميتك واللينوليك والاسيتارك وأخيرا حمض البالميتوليك وذلك في جميع العينات المدروسة. وقد حصل بيض الدجاج على أعلى القيم لكلا من حامض الأوليك والاسيتارك، بينما حصل بيض البط على أعلى قيمة لحامض البالميتك. وكانت أعلى قيمة لحامض اللينوليك فى بيض السمان، بينما أعلى قيمة لحامض البالميتوليك كانت فى بيض النعام. وقد أظهرت نتائج تحليل الأحماض الأمينية أن قيمة حامض الجلوتاميك كانت أعلى القيم وتبعها حامض الاسبارتك ثم الليوسين فى جميع عينات البيض تحت الدراسة.

وقد أظهر بيض الدجاج حصوله على أعلى القيم من كل من حامض الأسبارتك والليوسين بينما حصل بيض النعام علي أعلي نسبة من حامض الجلوتاميك . وفيما يتعلق بمحتوى البيض من العناصر المعدنية حصل بيض النعام على أعلى القيم لعنصر الحديد. وقد حصل بيض البط على أعلى القيم لكلً من الصوديوم والبوتاسيوم والزنك، بينما أعلى القيم في الماغنسيوم والفوسفور وجدت في بيض الدجاج.و كانت أعلي القيم لعنصر الكالسيوم في بيض السمان.

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