Ann. For. Res. 65(1): 4866-4876, 2022
ISSN: 18448135, 20652445

ANNALS OF FOREST RESEARCH
https://www.e-afr.org/

CHEMICAL ANALYSIS OF TWO SPECIES OF AFRICAN OSTRICH EGGS (*STRUTHIO CAMELUS MASSAICUS*) AND EUROPEAN OSTRICHES BRED IN IRAQ

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Abstract:
This research was conducted in the poultry Laboratory of the Department of animal production at the Faculty of Agriculture, University of Basra, for the period from 1/11 to 1/12/2019 and used 100 eggs of ostriches of two different breeds (African, European), dividing the eggs into two groups, each group included 50 eggs. The research aimed to find out the chemical analysis of the basic composition of the egg (yolk and albumin) and made a comparison between their chemical components, which is a recent study in the region. The results of the study indicated that there are significant differences ($p<0.05$) between the average qualities studied, where the chemical analysis of the egg components in African ostrich eggs was significantly superior ($P<0.05$) compared to the specifications of European ostrich eggs in terms of the yolk and albumin content of some minerals and amino acids, vitamins, and fatty acids, These values can be adopted as a standard indicator of the components of African and European domesticated ostrich eggs in the region.
Keywords: African, European ostrich eggs, Chemical analysis of eggs.

Introduction:

It is very important and necessary to evaluate ingredients of poultry eggs. Because these ingredients are the basis for embryo growth in the case of hatching eggs or for determining the nutritional value of eggs, they also indicate any decrease in nutrient level in poultry feed if environmental and other genetic factors persist (Kashmiri, 1986). A number of environmental and genetic factors, such as bird type and breed, female size, nutrition, and egg production season, influences the proportion of nutrients in the egg. (National Institute of Nutrition 2006, Cornetto et al., 2003 Di Meo et al., 2003). Ostrich eggs were considered an important source of proteins, calories, omega-3 and vitamins, as well as good carbohydrate, calcium, iron, potassium and sodium (Cook & Briggs, 1977). Ostrich eggs help build and repair muscle tissue in the body, promote the health of the nervous system and strengthen the process of nervous communication between the brain and the rest of the body. Nutrients in ostrich eggs also contribute to enhancing the brain's cognitive functions and improving learning ability. Some people do not realize that ostrich eggs help to lose weight, because they are considered semi-fat and rich in essential amino acids Abdallah, (2018). This makes their consumption saturated for hours at a time. Because the

number of research conducted on ostrich eggs is limited and did not meet the required amount of information with the modern trend of breeding this enchanting bird recently in Iraq, especially in the southern region, we conducted a comparative study of the chemical analysis of two types of ostrich eggs, which were chased under Iraq's climatic.

Materials and methods:

This study was conducted at the Faculty of Agriculture, Animal Production Department in the poultry management laboratory for the period from 1\9\2020 to 4\12\20, where 100 ostrich eggs were used, divided into two groups: 50 African ostrich eggs and 50 European ostrich eggs were obtained from the Sada Research Center, ostrich Reserve in Babylon, from females fed on known and registered feeders. Eggs were weighed directly by a sensitive balance at (0.00 g). The internal components were weighed after breaking the eggs, and their internal components (yolk, albumen) were carefully isolated by filter paper, 200 ml of both yolk and albumen were taken to perform analyze to measure, the chemical composition, including moisture, carbohydrates, protein, fats, cholesterol and ash by The AOAC method where the humidity was measured by drying the samples in a convection oven at a temperature of 97 degrees Celsius for 24 hours, while the ash percentage was measured by incinerating the samples taken by the incinerator at a temperature of 500 degrees Celsius for 7 hours. The percentage of fat on all samples was analyzed using a mixture of a 1: 1 ratio of chloroform to methanol and stirred for 20 minutes using a magnetic mixer for several times. The protein was determined by the semi - microkjeldal method, the percentage of nitrogen was determined percentage, and the numerical constant 6.25 to obtain the percentage of protein multiplied the obtained values. Carbohydrates were determined by subtracting moisture, ash, percentage of fat and protein from 100 (Shibusawa et al., 2001). Cholesterol was determined by ferric ethanol chloride chromatographic method using a spectrophotometer (LKB Ultra spectral) (Franey &Elias, 1968). The concentration of essential amino acids, saturated and unsaturated fatty acids in the egg and the amount of vitamins dissolved in fat (E, D, K) in the yolk and white mixture were measured. The sample volume was 250 milliliters after drying and cooling at a temperature of -20 degrees Celsius until laboratory analyzes were performed. Some mineral elements such as calcium, phosphorus, potassium, iron and manganese were measured by the atomic absorption spectrometry method (Oman &Wu, 2009).

Statistical analysis: Data were collected in the study for variance analysis in a generic linear model (GLM) using the statistical analysis system SAS (2009) while the Duncan test was used to calculate differences in morale differences at a morale level ($P > 0.05$).

Results and Discussion:

1. The chemical composition of the yolk and albumen of African and European ostrich eggs:

The results in (Table 1) indicated the chemical composition of albumin and yolk of African and European ostrich eggs bred in Iraq. The results show significant differences ($p< 0.05$) between two type of eggs, as far as the results showed that the moisture and ash contents were a higher in African ostrich egg albumen compared to the moisture and ash content in European ostrich egg albumen, the values were as follows (81.09, 46.01 and 83.00, 48.21) and (2.20, 1.56 and 2.11, 1.38), respectively, than in the yolk of both African ostrich egg albumin and European ostrich egg

albumin. Chemical analysis of egg fat found that the percentage of fat and cholesterol in albumin was 0%. As for the percentage of carbohydrates and fats in African and European egg yolks, it is estimated at (1.10 and 0.22), respectively, the sample of African ostrich egg yolk recorded as a higher percentage of cholesterol in African ostrich eggs 14.09 compared to the percentage of cholesterol in the European ostrich egg yolk was 13.34 while the protein content in African ostrich egg yolk and European ostrich egg yolk was higher by (19.92 and 16.12 compared with the albumin content of protein in both African and European ostriches are as follows (15.68 , 13.02), which means that the egg albumen of both African ostrich eggs and the egg albumen of European ostrich had a higher moisture and ash content than the yolk of African ostrich eggs and the yolk of European ostrich eggs . These results are consistent with what those researchers were found (Al-Obaidi et al., 2013 and Amao et al., 2019, Selvan et al., 2014). The reason for the high proportion of ash, mineral elements, may be due to the fact of the great need for these elements for the purpose of building a strong ostrich skeleton, which is consistent with the size and thickness of the bones, which is derived primarily from egg yolk. This may be due to the fact that the skeleton of the developing ostrich embryo being huge and hard, bone tissue needs large amounts of mineral elements, which must be provided in the yolk of ostrich eggs (Szczerbińska, 2010). These results came in an approach to the results conducted by the researchers, (Selvan et al., 2014) which summarized the results accordingly that dry matter, raw protein, ether extract, total ash and gross energy would be 12.87 ± 0.22 per cent, 10.94 ± 0.42 per cent, 6.98 ± 0.35 per cent, 0.61 ± 0.02 per cent and 1512 ± 22.76 kg/kg, respectively. In another study by Italian researchers, Superchi et al. (2002), they referred to the values of chemical analysis of ostrich eggs that the moisture, protein and ash content (%) is 89.51, 9.56 and 0.88 in gaffe and yolks was observed as 51.21 moisture, 15.19 protein, 31.37 fat and 2.10 ash. Explained in their study in Romanoff and Romanoff, (1949) reported that moisture, protein fat, ash and carbohydrates in ostrich eggs are 75.1%, 12.2%. 11.7%, 1.4% and 0.7% respectively. The reason for the different results may be due to obvious differences in feeding methods and environmental factors, as well as perhaps because of the different domesticated breeds in those studies. The different results may be attributable to obvious differences in feeding methods and environmental factors, as well as perhaps to the variation of domesticated strains in such studies. Moreover, the methods of assessing nutrients chemically and calculatedly in eggs by these researchers are different.

Table 1. Chemical analysis of African and European ostrich albumen and yolks %

Treats	European ostrich		African ostrich		Sign. Yolk	Sign.Albu.
	Yolk	Albumen	Yolk	Albumen		
%Humidity	48.21±0.83[a]	83.00±0.65[a]	46.01±0.77[b]	81.09±0.78[b]	**	
Ash%	1.38±0.03[a]	2.11±0.10[a]	1.56±0.9[a]	2.20±0.05[a]	*	NS
Carbohydrates%	0.22±0.08[b]	0.87±0.05[b]	1.10±0.9[a]	1.03±0.04[a]	NS	*
Cholesterol mg.g	13.34±0.78[b]	---------	14.09±0.88[a]	----------	*	*
Protein%	16.12±o.67[b]	13.02±0.86[b]	19.92±0.65[a]	15.68±0.70[a]	**	**

Fats%	33.45±0.91[a]	---------	31.41±0.84[b]	----------	**	**

Values shown are mean ± SD (standard deviation)
a, b values in rows with no common superscripts differ significantly (P<0.05).

2. The amount of mineral elements in the albumen and yolk of African and European ostrich eggs:

Table (2) shows the content of African and European ostrich eggs of mineral elements, so the results of the analysis of samples of ostrich eggs taken to find out the level of some mineral elements in eggs. The results show a high significant differences (P<0.05) between the treats, The results indicated a high level of calcium, phosphorus, iron, zinc, magnesium and manganese in the yolk of African ostrich eggs and the yolk of European ostrich eggs as follows (256.24 , 255.17 , 9.94 , 1.57 , 18.67 3.25 ppm) and (139 , 250 , 8.91 , 1.00, 16.36, 2.0) ppm respectively, compared to the rate of the values of these minerals in the albumen of African and European ostrich eggs (27.23, 14.67 , 3.12 , 0.83 , 9.82 , 1.92) ppm and (26.01 , 13.29 , 3.01 , 0.51 , 8.55 , 0.94 ppm) consecutively, These results agreed with the results of Ferial et al., (2008) who conducted a study to estimate the level of some mineral elements in African ostrich eggs bred in Egypt the results of this study agreed showed the level of Calcium, Phosphorus, Iron, Zinc was 206.5, 683.8, 11.20, 5.20 mg/100 of dry weight. Although there were no significant difference between the yolk and albumen of the African and European ostrich eggs in terms of amount of iron. The findings of study Al-Obeidi et al., (2015) showed the levels of calcium, phosphorus, magnesium, iron, zinc and magnesium were (27, 18, 10, 2, <1.0, <1.0) in albumen sequentially and (145, 334, 15.7, <1.0, <1.0) in ostrich egg yolks respectively. The different values of mineral elements in ostrich egg albumen and yolks taken in this study compared to other studies may be attributed to several factors, including Genetic influences factors, different strains and geographical location of ostrich life, as well as the different connections provided and their components (Idowu, 2006), as well as other administrative and environmental factors (Ajantha, et al., 2017).

Table (2) the content of African and European ostrich eggs of some mineral elements

Treats Metal elements (ppm)	Treats (eggs)				Sign. Yolk	Sign. Albu.
	European ostriches		African ostriches			
	Yolk	Albumen	Yolk	Albumen		
Calcium	139±1.10[b]	26.01±1.78[b]	256.24±11.01[a]	27.23±3.42[a]	**	*
Phosphorus	250±1.54[b]	13.29±1.11[b]	255.17±2.59[a]	14.67±2.2[a]	*	*
Iron	8.91±0.05[a]	3.01±0.04[a]	9.94±2.00[a]	3.12±0.04[a]	NS	NS
Zinc	1.00±0.06[b]	0.51±0.8[b]	1.57±0.05[a]	0.83±0.01[a]	*	*
Magnesium	16.36±0.81[b]	8.55±0.84[b]	18.67±1.03[a]	9.82±0.01[a]	**	*
Manganese	2.00±0.7[b]	0.94±0.7[b]	3.25±0.03[a]	1.92±0.06[a]	*	**

Values shown are mean ± SD (standard deviation) .
a, b values in rows with no common superscripts differ significantly (P<0.05).

3. Estimation of amino acids in the egg (mg / g) of dry matter:

The table (3) shows a comparison of the levels of amino acids between the yolks and albumen of African and European ostrich, the statistical analysis showed, there are significant, obvious differences (P<0.05) between the yolks and the albumin of African and European ostrich eggs, However, the results showed that the amino acid Valine was in a similar proportion in the egg yolk of both African and European ostriches it's (11.7,11.0) mg/g. Subsequently, the amino acids arginine, tyrosine, cysteine, alanine glycine, proline, glutamic acid, serine, threonine, isoleucine, leucine, histidine, methionine, recorded their highest values in the yolk of the ostrich. Albumen of European ostriches eggs, reaching (14.5, 8.4, 2.8, 10.0, 6.7, 17.4, 48.9, 17.9, 10.7, 11.7, 9.3, 20.5, 6.0, 2.6) mg\g. the results of the table below where it was observed that the levels of essential amino acids were varying in the yolks and albumen of both species, where, a highest levels of essential amino acids appeared in the albumen and yolks of African ostrich eggs, compared to their levels in the albumen and yolks of the European ostrich eggs. May be this increase caused by variations in strains and types of nutrition and by variations in protein metabolism in egg-producing female organisms under different environmental, nutritional, and physiological conditions. These results are consistent with the results of the study conducted by these investigators (Shahin et al., 2006).

Table (3) amino acids in the eggs (yolk / albumen) of African and European ostriches.

Amino acids mg /g	Treats (eggs)				Sig. Yolk	Sig. Albu.
	European ostriches		African ostriches			
	Yolk	Albumen	Yolk	Albumen		
Arginine	13.6±0.262^{b}	9.0±0.462^{b}	14.5±0.214^{a}	10.0±0.202^{a}	*	*
Tyrosine	10.1±0.062^{b}	11.5±0.332^{b}	8.4±0.044^{a}	13.0±0.114^{a}	**	**
Cysteine	5.5±0.532^{b}	5.0±0.182^{b}	2.8±0.213^{a}	6.7±0.327^{a}	**	*
Alanine	8.8±0.411^{b}	9.5±0.328^{b}	10.0±0.226^{a}	11.8±0.138^{a}	*	**
Glycine	4.12±0.221^{b}	6.1±0.114^{b}	6.7±0.254^{a}	8.6±0.381^{a}	**	**
Proline	12.0±0.110^{b}	13.1±0.121^{b}	17.4±0.052^{a}	15.7±0.207^{a}	**	**
Glutamic acid	42.9±0.432^{b}	46.4±0.064^{b}	48.9±0.127^{a}	51.5±0.090^{a}	**	**
Serine	16.7±0.221^{b}	17.1±0.285^{b}	17.9±0.423^{a}	20.7±0.198^{a}	**	**
Threonine	15.4±0.621^{b}	14.3±0.947^{b}	10.7±0.732^{a}	16.8±0.242^{a}	**	**
Valine	11.0±0.042^{b}	12.1±0.423^{b}	11.7±0.441^{a}	14.8±0.346^{a}	NS	**
Isoleucine	8.3±0.231^{b}	10.0±0.221^{b}	9.3±0.389^{a}	11.8±0.055^{a}	*	*
Leucine	18.9±0.266^{b}	19.1±0.842^{b}	20.5±0.331^{a}	23.9±0.072^{a}	**	**
Histidine	4.8±0.442^{b}	4.0±0.011^{b}	6.0±0.553^{a}	6.3±0.212^{a}	**	**
Methionine	1.4±0.098^{b}	1.6±0.123^{b}	2.6±0.221^{a}	3.8±0.135^{a}	**	**

Values shown are mean ± SD (standard deviation).
a, b values in rows with no common superscripts differ significantly (P<0.05).

4. Estimation of the percentage of vitamins in the albumen and yolk of African and European ostrich eggs (mg /100 g):

The results in a table (4) below show Estimation of the percentage of vitamins in the albumen and yolk of African and European ostrich eggs. The results of the statistical analysis showed the presence of significant, obvious differences, (P<0.05) represented by the amount of vitamins valued in the yolk and albumen of African and European ostrich eggs. There was a highly significant (P<0.05) variation level of vitamins in the yolks and albumen. The level of vitamins in the European ostrich egg was the a highest compared to their levels in the yolks and albumen of the African ostrich eggs, While there were no significant differences (P<0.05) between the level of two vitamins, thiamine, and niacin, the amount of which was estimated as follows: (0.001 0.026, 0.004 0.031) mg /100 g, (0.9, 0.03, 0.9, 0.14) mg/100g. Moreover, this difference may be due to the varied environmental impact on domesticated birds in fields or farms as well as the quality of the nutrition provided to Hen (Leeson and Caston 2003, House 2002) which refers in their report feed vitamin concentration, and mainly water-soluble vitamins, has been shown to affect vitamin egg white concentration. Riboflavin, folic acids, niacin, thiamine, pyridoxine, pantothenic acid, biotin, and vitamin B12 were well transferred into the egg white and their concentrations depend on feed concentration. The composition of egg whites is associated with water-soluble vitamins and the concentration of certain trace elements in food, Egg yolk vitamins, trace elements, and carotenoids concentration could be adjusted according to the feed concentration (Ajantha, et al., 2017) In addition; genetic and physiological factors associated with the female ostrich's body may affect the level of vitamins in the eggs. These causes lead to various quantities of vitamins in the egg. These findings are similar to those that the researcher has found (Amao, 2019).

Table (4) Estimation of the amount of vitamins in the albumen and yolk of African and European ostrich eggs.

Values shown are mean ± SD (standard deviation).
a, b values in rows with no common superscripts differ significantly (P<0.05).

5. Estimation of saturated and unsaturated fatty acids in the egg yolks of African ostriches and European ostriches:

Table (4) shows a significant difference (P<0.05) between saturated fatty acids and unsaturated fatty acids in the yolk of African and European ostrich eggs. The results indicated that these percentages are significantly higher in the yolk of African ostrich eggs compared to their values in the yolk of European ostrich eggs, The statistical analysis of the present results didn't show significant differences (p<0.05) between the following fatty acids: Lauric (C12:0), oleic

Vitamins	Treats (eggs)				Sig. Yolk	Sig. Albu.
	European ostriches		African ostriches			
	Yolk	Albumen	Yolk	Albumen		
Vitamin A	23.07±0.02^{a}	----------	22.01±0.01^{b}	----------	***	-
Vitamin E mg	0.56 ±0.07^{a}	0.39±0.09^{a}	0.42±0.03^{b}	0.20±0.04^{b}	*	*
Folic acid ppm	0.2±0.06^{b}	2.51±0.12^{a}	0.3±0.04^{a}	1.01±0.16^{b}	*	*
Pantothenic acid	12.2±0.42^{b}	44.45±0.3^{a}	14.8±0.11^{a}	40.9±0.21^{b}	**	**
Thiamine ppm	0.031±0.02^{a}	0.004±0.01^{a}	0.026±0.06^{b}	0.001±0.00^{a}	NS	NS
Riboflavin ppm	0.10±0.00^{a}	0.14±0.00^{a}	0.06±0.05^{b}	0.10±0.00^{b}	**	**
Niacin	0.14±0.00^{a}	0.9±0.00^{a}	0.13±0.03^{a}	0.9±0.00^{a}	NS	NS

(C18: 1), Myristoleic (14: 1), Palmitoleic (16: 1) in the yolk of African and European ostrich eggs, where it was (0.47,34.98,2.00,4.03). In a study Benkhayal et al., (2007) that aimed to show the difference between the nutritional value of chicken eggs compared to the nutritional values of ostrich eggs, the results found that the total fatty acids in Ostrich egg yolk and hen′s egg yolk showed the presence of (C12:0 –0.0, 0.39%), (C14:0 –1.35, 0.84%), (C14: 1 –0.0, 0.63%), (C16:0 –28.85, 26.5%), (C16: 1 –6.83, 5.96%), (C 18:0 –8.75, 8.20%), (C18: 1 –31.36, 38.97%), (C18: 2 –18.08, 16.5%), (C18: 3 –2.4, 1.12%) and (C22: 6 –2.38, 0.89%), respectively. These results were consistent with the results of the study of researchers Di Meo et al., (2003). Shahin et al., (2006) indicated that the fatty acids composition of the Ostrich egg yolk showed the presence of (C12:0 –0.2%), (C14:0 –1.0%), (C16:0 –3.9%), (C16: 1 –33.3%), (C 18:0 –8.9%), (C18: 1 –37.4%), (C18: 2 –14.6%) and (C18: 3 –0.8%). these values were significant (P<0.01). Nutritional values were, total saturated fatty acids (66.554%), total un saturated fatty acids (33.445%), total fatty acids (94.257), In a study conducted by these researchers (El-Shawaf et al., 2011) aimed to find the difference in the chemical composition of ostrich eggs and chicken eggs, they found the

proportions of fatty acids were as follows Lauric (12:0) 14.154, (14:0) 20.673, (16:0) 18.539, (18:0) 1.204, (16:1) 2.052, (18:1) 9.963 (18:2) 12.733, (18:3) 1.396, (14:1) 4.900, (16:1) 2.052. Respectively, We suggest that the reason for this discrepancy in the proportions of fatty acids in eggs may be due to some reasons, like, quantity and quality of feed consumed, body weight, the varying content of nutrition, including the quantity and quality of feed consumed, body weight, the varying content of feed fats (Keum et al., 2018) and their sources (Kim et al.2019), as well as liver activity in birds, a clear effect on the level of fatty acids in the blood and eggs, as well as the percentage of fat in the body (Beynen, 2004).

Table (5) saturated and unsaturated fatty acids in the yolk of African and European ostrich eggs.

Saturated and unsaturated fatty acids	European ostrich	African ostriches	Sig.
	Yolk	Yolk	
Lauric (C12:0)	0.47±0.213[a]	0.52±0.103[a]	NS
Myristic (C14:0)	2.17±0.033[b]	0.64±0.042[a]	**
Palmitc (C16:0)	3.21±0.041[b]	4.21±0.064[a]	**
Palmitoleic(C16:1)	33.0±0.011[b]	35.0±0.921[a]	**
Stearic (C18:0)	6.53±0.065[b]	7.90±0.425[a]	**
Oleic (C18: 1)	34.98±0.034[a]	35.01±0.070[a]	NS
Linoleic (C18: 2)	11.31±0.056[b]	13.80±0.033[a]	**
Linolenic (C18: 3)	1.46±0.112[a]	0.91±0.022[b]	*
Myristoleic (14:1)	2.00±0.063[a]	2.14±1.061[a]	NS
Palmitoleic (16:1)	4.03±0.025[a]	4.48±0.049[a]	NS
Arachidonic (20:4)	0.49±1.388[b]	0.91±0.327[a]	*
Stearic (C18:0)	5.91±0.735[b]	6.43±0.122[a]	*
Palmitic (C16:0)	3.95±0.057[b]	4.82±0.939[a]	**

Values shown are mean ± SD (standard deviation).
a, b values in rows with no common superscripts differ significantly ($P<0.05$).

Fatty acids have a strong association with promoting the pathogenesis of diseases such as cardiovascular disease, cancer, and inflammatory and autoimmune diseases (Wang, et al., 2008; Zhu et al., 2019). However, ostrich eggs, whether African or European, are low in harmful fatty acids compared to other types of eggs, and then, there are many studies that recommend the use of ostrich eggs for people suffering from heart disease, blood vessel blockage and high cholesterol in the blood, (Ga et al., 2011), which this study also confirmed the presence of saturated fatty acids in higher quantities than unsaturated fatty acids.

In conclusion, the results of this study show that there is a clear difference between the content of African ostrich eggs of nutrients compared to their levels in European ostrich eggs, but ostrich

eggs in general contain good levels of nutrients necessary for a healthy body free of diseases, which encourages much research on this amazing bird.

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