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PHYSICAL CHARACTERISTICS, CHEMICAL COMPOSITION AND FATTY ACID PROFILE OF OSTRICH EGGS

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Abstract: A study was conducted to assess the physical characteristics, chemical composition and fatty acid profile of ostrich eggs. Fifteen eggs were collected randomly and used for the conduct of study. Studies revealed the average size to be 1435.1 ± 20.10 g, length 151.5 ± 0.83 mm, width 113.6 ± 0.34 mm, shell thickness 2.56 ± 1.12 mm and shape index 74.2 ± 0.82. Three principal components amounted to 825.35 ±12.26 g (57.51%), 396.76 ± 12.34g (27.64 %), and 212.89 ± 11.23 g (14.83 %) respectively for albumen, yolk and egg shell. The value of yolk colour was 4.23 ± 0.24 and content of calcium was 35.22 ± 0.67 %. The proximate composition revealed the percent CP, Fat, Ash, Dry Matter and GE (Kcal/ kg) as 10.93 ± 0.42, 6.98 ± 0.35, 0.61 ± 0.02, 12. 87 ± 0.45 and 1512 ± 22.76 respectively. The fatty acid composition (%) of the yolk showed the presence of 11 fatty acids, viz; Myristic Acid (0.42 ± 0.03), Palmitic Acid (29.7 ± 0.25), Stearic Acid (1.70 ± 0.21), Oleic Acid (39.63 ± 0.99), Linoleic Acid (16.49 ± 0.49), Linolenic Acid (0.68 ± 0.04), Arachidic Acid (1.04 ± 0.10), Behenic Acid (1.88 ± 0.10), Ecosapentaenoic Acid (0.78 ± 0.07), Docosahexaenoic Acid (0.46 ± 0.05) and Palmitoleic Acid (7.22 ± 0.15). The cholesterol content was 11.36 ± 0.35 mg/g of yolk. It can be summarised that the ostrich egg has almost similar physical, chemical and biochemical properties, but a higher content of fatty acid profile and lower cholesterol content compared to chicken eggs.
Keywords: Ostrich eggs, egg weight, albumen index, fatty acid, Linolenic acid, Palmitic Acid, cholesterol

Introduction

Ostrich farming was started in India during the year 2000, as a pilot study to assess their adaptability and survivability. Even though it has good capacity to grow at a faster pace, it has been at a low level due to various reasons. It was also contemplated to be a good alternative to chicken farming. The potential of ostrich farming has not been fully utilised. Among the various constraints, breeding, hatching and chick management are the major areas, where more intense researches are required.

According to Narushin and Romonav (2002), avian egg is a highly complicated biological system, in which physical and chemical characteristics deeply affect the incubation process,

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embryos development and hatching. They have further determined the optimal ranges of weight, shape index, shell thickness and porosity for commonly bred avian species. Like chicken eggs, ostrich eggs also have valuable data on their physical and chemical properties. Very little work has been carried out in the elucidating the ostrich egg nutrition. Poor ostrich egg nutrition will indicate poor chicks. The distribution of egg nutrition would be sufficient enough to get good and healthy chicks. According to Angel (1994), the nutrients required for embryo development are pre-packaged in the egg prior to laying. The fatty acid component plays a major role in determining the embryo survivability. The poly unsaturated profile of the yolk varies greatly between the different avian species (Surai, et.al, 1999).

It is imperative to have a correct knowledge of the nutrient requirements of adult birds for different stages of laying to have a good nutrient profile required for healthy embryo growth. The detailed profile will also help in the reduction of chick mortality, which is another major factor in the growth of ostrich industry. With these points on mind, the current work was undertaken to assess the nutrient profile of ostrich eggs.

Materials and Methods

Ostriches are being reared at the Post Graduate Research Institute in Animal Sciences (formerly Livestock Research Station), Kattupakkam, a flagship research institute of Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu, India since 2000.

Under Indian conditions, the breeding season in ostrich is being observed during December to July, even though the eggs are being laid round the year. Sexually active birds have been newly introduced into the breeding paddocks along with the males. The breeding birds are maintained in trios, pairs and in colonies. Fifteen eggs from four year old hens were randomly collected and used for the study. These eggs were subjected to various physical and chemical properties to ascertain their nutrient profile. The results coming out of this study would help in assessing their nutrient requirements during laying stage and this in turn would be correlated with the hatching performance and subsequent chick liveability. A comprehensive study would help in improving the overall performance of the birds. Another purpose for this study was to help us in ascertaining their nutrient profile for human consumption.

The eggs were collected fresh and subjected to various physical and chemical analysis immediately. The eggs were first subjected to physical analysis like egg weight, length, width, shape index and shell thickness. Subsequently they were opened in large end and yolk, albumen and shell were separated out. All the eggs were weighed individually and calculated

as percentage of total egg. The yolk was assessed for their colour quality using the Roche yolk colour fan and the shell was assessed for their calcium content. A homogenous sample of each component was used for detailed chemical analysis as per A.O.A.C 1984. The data collected from the above observations were subjected to statistical analysis as per the standard statistical tool (SPSS 11.0).

Results and Discussion

The results pertaining to the external physical characteristics are given in Table.1.

The results revealed that the average size of the egg was 1435.1 ± 20.10 g, length 151.5 ± 0.83 mm, width 113.6 ± 0.34 mm, shape index 74.2 ± 0.82, shell thickness 2.56 ± 1.12 mm, yolk colour 4.0 and calcium content in egg shell as 35.2 ± 0.67. Elsayed (2009) reported the egg weight in ostriches of Egypt to be between 1233.2 to 1478.9 g, length 144 to 152 mm, width 116 to 129 mm, shape index 80.6 to 84.9, shell thickness 1.92 to 2.4. Except for shape index and shell thickness, other parameters are almost similar in quality. Ostrich egg represents 1.25 to 1.5% of the body weight of female ostrich compared to chicken eggs which is almost 1.7% (Deeming,1996). Sales et al (1996) reported that the average egg weight is 1444 g and it varies during laying. The authors also informed that the average egg shell thickness is in the range of 1.82 to 2.02 mm. It has been observed by Franco and Beck (2007) that ostrich egg is an exception, with a high shape index of 80 % more than other birds. Average shape index as observed by Keffen and Jarvis (1984) is 82.86. Di Meo et al (2003) assessed the external quality of ostrich egg and reported the average length to be 154 mm, width 129 mm and shell thickness 2.20 to 2.24. The size of ostrich egg reported by Di Meo et al is slightly bigger than what has been reported in this study. There are many factors which influence the external qualities of egg. It may be weather, location of the farm, diet/ nutrition and physiological factors, while genetics also play an important role (Cooper, 2000 and Aganga et al, 2003). The wide differences in physical qualities may be mainly due to the fact that ostrich have unique characteristics of their own (Elsayed, 2009).

The results pertaining to the proportionate principal components are given in Table.2.

The results revealed that albumen yolk and egg shell percentage was 57.51 (825.35 g), 27.64 (396.76 g) and 14.83 (212.89 g) respectively. Superchi et al (2002) reported the percentage of albumen, yolk and egg shell was 55.25, 24.28 and 19.86 which is lower compared to the results obtained by us in respect of albumen and yolk and higher in the case of egg shell. Romanoff and Romanoff (1949) reported the percentage of albumen (53.4), yolk (32.5) and yolk (14.1). Egg shell) which is lower compared to our findings in albumen and

egg shell. It is higher in respect of yolk content (32.5 vs 27.6). Di Meo et al (2003) assessed the internal quality of ostrich egg and reported similar albumen percentage (57.1 vs 57.5), lesser yolk value (23.3 vs 27.64) and higher shell percentage (19.6 vs 14.83). Superchi et al (2002) observed in their study that both albumen and yolk percentage are significantly correlated with egg weight, but with a negative relationship for yolk and positive for albumen. Such observation was not made in our study.

The results pertaining to the proximate composition of ostrich eggs are given in Table.3.

The results revealed that the dry matter, crude protein, ether extract, total ash and gross energy to be 12.87 ± 0.22%, 10.94 ± 0.42%, 6.98 ± 0.35%, 0.61 ± 0.02% and 1512 ± 22.76 Kcal/kg respectively. Superchi et al (2002) conducted a study in Italy and revealed moisture, protein and ash content (%) to be 89.51, 9.56 and 0.88 in albumen and in yolk it was observed as 51.21 (moisture),15.19 (protein), 31.37 (fat) and 2.10 (ash). Romanoff and Romanoff (1949) reported the moisture, protein fat, ash and carbohydrates in ostrich egg as 75.1%, 12.2%. 11.7%, 1.4% and 0.7% respectively. Among the ratite species, ostrich egg has higher protein (11.2 vs 12.2) and less fat (11.7 vs 12.6) than emu egg (Sales et al, 1996).

The results pertaining to the fatty acid composition and cholesterol content of ostrich eggs are given in Table 4.

The study revealed the presence of 11 varieties of fatty acids with 42.19, 46.85 and 18.41 percent of saturated, monounsaturated and polyunsaturated fatty acids respectively. Oleic acid and Palmitic acid were available at the highest level at 39.63 ± 0.99 and 29.76 ± 1.25 respectively. Di Meo et al (2003) reported the presence of oleic acid (C18:1), palmitic acid (C16:0), stearic acid (C18:0) and linoleic acid (C 18:2) at 12.2 – 13.64 %, 4.08 – 4.6 %, 1.92 – 2.12% and 1.71 – 1.96% respectively. Our study also revealed similar trend of having highest level of oleic and palmitic acid in ostrich eggs though the value differed widely. Noble et al (1996) carried out a comparative study on lipid composition of egg yolk and concluded that the fatty acid composition of farm reared ostriches were different from the wild ones, especially in the linolenic acid which showed 80% less in farm reared birds. This could be one of the factors for higher hatchability percentage in wild birds than farm reared birds. A study conducted by Sussi et al (2003) also revealed higher value for oleic acid (39.10%) and palmitic acid (30.26%). The value obtained in our study was in accordance to the value obtained by Sussi et al (2003). However, our study revealed the presence of 11 varieties of fatty acids against 22 varieties recorded by Sussi et al (2003). A better analytical method with higher column would have revealed the presence of more fatty acid in our study.

The saturated fatty acid (42.19 vs 36.26) and polyunsaturated fatty acid (18.41 vs 15.45) found in our study was little higher and monounsaturated fatty acid (46.85 vs 47.61) was lower than the results obtained by Sussi et al (2003). The difference in fatty acid composition can be attributed to the dietary ingredients used in the preparation of feed for the birds.

The cholesterol content in ostrich egg was observed to be 11.36 mg/g. Horbanezuk et al (1999) reported cholesterol content in ostrich egg to be 13 mg/g which is higher than our findings. Di Meo et al (2003) reported the cholesterol content of yolk to be between 10.6 and 10.9 mg/g, which is less than the result obtained in our study. Jaroslaw Olav Hor banezuk et al (2003) reported mean cholesterol content in Nandu (Rhea) egg to be 16.41 mg/g which is considerably higher than ostrich egg and similar to guinea egg (16 mg/g). Other parameters observed were saturated fatty acids (32.51%), polyunsaturated fatty acids (33.55%) and monounsaturated fatty acids (33.24%). It is a known fact that fatty acid composition can be altered with nutrition. Hence, the feeding regimen, types of ingredients used in feed preparation should also be taken into consideration during the assessment of fatty acid profile of egg yolk. A more comprehensive study is required in this aspect.

Conclusions

The study on the evaluation of physical and chemical properties of ostrich eggs revealed the average weight, length, width, shape index, shell thickness yolk colour and egg shell calcium to be1435.1g, 151.5 mm, 113.6 mm, 74.2, 2.56 mm, 4.0 and 35.2 % respectively. The variations in this aspect of ostrich egg could be due to their own individual unique characteristics. Moreover, the egg characteristics (physical and chemical) observed in our study has not shown any major deviation from other countries. Diet/ nutrition, geographical location and rearing environment would have made changes; these changes have to be taken into account during developing a successful hatching program in a breeder farm. The cholesterol and fatty acid shows variation among the egg yolk of ostriches and also in comparison with other egg yolks. While studying the fatty acid profile and cholesterol, it is necessary to include the dietary composition, since the nutrition along with genetics and environment plays a major role in influencing the availability of the factors involved.

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Table No 1.

External physical characteristics of ostrich egg (Mean ± S.E)

S.No	Parameters	Mean ± S.E (n = 15)	MIN	MAX	STDEV
1	Egg weight (g)	1435.1 ± 20.10	1249	1653	118.08
2	Egg length (mm)	151.5 ± 0.83	133	159	7.18
3	Egg width (mm)	113.6 ± 0.34	102	126	7.03
4	Shape Index	74.2 ± 0.82	64.55	85.56	5.60
5	Shell thickness (mm)	2.56 ± 1.12	2.35	2.84	0.13
6	Yolk colour	4.0 ± 0.19	3	5	0.84
7	Egg shell calcium (%)	35.2 ± 0.67	21.42	48.95	8.22

Table No 2.

Proportionate principal components of ostrich egg (Mean ± S.E)

S.No	Parameters	Mean ± S.E (n =15)		MIN	MAX	STDEV
		(g)	(%)			
1	Albumen	825.35 ± 12.26	57.51	726.1	953	59.21
2	Yolk	396.76 ±12.34	27.64	341.2	463.2	40.21
3	Shell	212.89 ± 11.23	14.83	179.4	228.4	16.76

Table No 3.

Proximate composition of ostrich egg (Mean ± S.E)

S.No.	Parameters (%)	Mean ± S.E (n=15)	MIN	MAX	STDEV
1	Dry Matter	12.87 ± 0.22	11.25	14.4	0.96
2	Crude Protein	10.94 ± 0.42	7.56	14.25	1.79
3	Ether extract	6.98 ± 0.35	4.56	9.56	1.49
4	Total Ash	0.61 ± 0.02	0.4	0.9	0.11
5	Gross Energy (Kcal/kg)	1512 ± 22.76	13.56	1689	96.57

Table No 4.

Fatty acid composition and Cholesterol content of ostrich egg (Mean ± S.E)

S.No	Parameters	Mean ± S.E (n=15)	MIN	MAX	STDEV
1	Myristic Acid (%)	0.42 ± 0.03	0.15	0.65	0.16
2	Palmitic Acid (%)	29.76 ± 1.25	24.56	42.56	5.34
3	Stearic Acid (%)	1.70 ± 0.21	6.58	10.54	0.90
4	Oleic Acid (%)	39.63 ± 0.99	34.5	48.5	4.22
5	Linoleic Acid (%)	16.49 ± 0.48	13.26	19.68	2.05
6	Linolenic Acid (%)	0.68 ± 0.04	0.45	0.98	0.18
7	Arachidic Acid (%)	1.04 ± 0.10	0.25	1.75	0.46
8	Behenic Acid (%)	1.88 ± 0.10	0.58	2.65	1.88
9	Eicosapentaenoic Acid (%)	0.78 ± 0.07	0.17	1.35	0.31
10	Docosahexaenoic Acid (%)	0.46 ± 0.05	0.1	0.9	0.22
11	Palmitoleic Acid (%)	7.22 ± 0.15	6.25	8.71	0.64
Saturated fatty acids SFA (%)		31.88			
Monounsaturated fatty acid MUFA (%)		46.85			
Polyunsaturated fatty acid PUFA (%)		21.27			
Cholesterol mg/g		11.36 ± 0.35	9.56	14.25	2.52