

## Analytical studies of egg shell membrane of partridge (*Francolinus francolinus*)

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### Abstract

In this study, chemical composition of some external and internal egg shell membrane of partridge were compared. Essentially egg shell membrane is connective tissue. The organic matter of egg shell membrane contain protein as a major constituents with small amounts of carbohydrates and lipids. They consist almost wholly of protein except for very small amounts of water and trace minerals. Calcium is the chief mineral element in the outer and inner shell membranes. Other minerals, amino acids, moisture content, ash and total nitrogen of both egg shell membrane have also been analyzed.

*Key word:* Partridge egg shell membrane, mineral composition, crude protein, fat, total nitrogen, amino acid, HPLC, AAS.

### Introduction

It is becoming increasingly popular to raise partridge for hunting or conservation areas and for sale to the gourmet food markets. Birds raised for meat must attain marketable weight as early as possible, Although partridge have been raised domestically approximately 20 years in the world. They are still wild birds compared with other domesticated poultry<sup>1</sup>. Breeding of partridge has been increasing

intensively all over the world also. These birds are being breed for a material for hunting ground. But their meat is consumed with their delicious taste by people<sup>2</sup>. Eggs obtained from these birds are usually used for hatching.

Egg weight of partridge is between 19.16 and 22.50gm<sup>3</sup>. It was reported that egg weight of partridge is 20.84gm and also was reported that egg weight of partridge have not increased with age<sup>4</sup>. The shell thickness of

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partridge has been reported as 0.232mm<sup>3</sup>. Costilla *et al.*<sup>5</sup> have studied the developmental stage effects egg shell breaking strength in two ground nesting birds: the partridge and the quail. They also studied eggs in the red-legged partridge<sup>6</sup>. Tikki and Saatis<sup>7</sup> have studied the effects of storage time on external and internal characteristics in partridge eggs. The effect of different breeding systems on egg productivity and egg quality characteristics of rock partridge have been reported by Ozbey and Esen<sup>8</sup>.

The egg shell comprises calcified shell and shell membranes including inner and outer membranes<sup>9,10</sup>. These membranes retain albumin and prevent penetration of bacteria<sup>11</sup>. Egg shell membranes are also essential for the formation of egg shell<sup>12</sup>. The organic matter of egg shell and shell membranes contain protein as major constituents with small amount of carbohydrates and lipids<sup>13-17</sup>. However, little is known about the difference in concentration of organic constituents, mineral and fat between the inner and outer egg shell membranes<sup>18,19</sup>.

In continuation to our earlier work<sup>20</sup>, it was aimed to determine mineral composition, moisture, ash, crude protein, crude fat, amino acid and total nitrogen of both egg shell membranes of partridge and also aimed to compare between them.

## Materials and Methods

Depredated and deserted eggs of red legged partridge were collected from the forest of Radha Rani; miner of Nagla Dani and Nagla Vinda, Tehsil-Mant, Mathura (U.P.). The procedure for locating eggs was done through

the study area where reproductive pairs and incubating females were previously observed. While looking bushes and herbs most of the eggs were found insolated and dispersed in the field. Others were collected with the help of hunters, farmers, game keepers and volunteers in area of 2200 ha.

The shell membrane that covers the conic layer of the egg shell can block the view of the inner part of the egg shell, the connection between the membrane and conic layer is very tight<sup>21</sup> and thus removal of membrane from the conic layer by mechanical methods is impossible. Removal of organic membrane requires chemical methods. Use of acids in this case is not recommended, since calcite reacts with various acids<sup>22</sup>. Therefore we used 5% NaOH to remove the membranes<sup>23</sup>. Samples were incubated in micro tubes with 5% NaOH placed in boiling water bath for 10 to 20 min. Moisture and ash content of egg shell membrane was determined following combustion at 500°C in a muffled furnace for four hours. The amino acids were analyzed using the HPLC method<sup>24</sup>. Minerals were analyzed by the standard AOAC methods<sup>25</sup>. Data were analyzed according to a 3 (energy)×3 (protein) factorial design with energy and protein levels featuring as main factors<sup>26</sup>.

## Result and Discussion

Total mineral, moisture and ash contents of partridge are given in table 1 and 2 respectively.

Calcium is the chief mineral element in the outer and inner shell membranes. Outer shell membrane contain slightly more calcium

than the inner shell membrane and so their mineral oxide. Mineral magnesium, phosphorus, sodium and their corresponding oxides are found in traces in the outer and inner shell membranes. Minerals magnesium and sodium are found more amount but phosphorus is less amount in outer shell membrane than inner one and their corresponding oxides.

Moisture content is found in lesser amount but ash content is greater amount in the outer shell membrane than the inner shell membrane. Ash unaccounted for is greater in the case of outer shell membrane than inner shell membrane.

#### *Organic constituents :*

Crude fat and crude protein contents of outer and inner shell membranes are given in table 3. Component amino acids are given in the table 4.

Table 3 indicates that crude fat of outer shell membrane is found in greater amount than the inner shell membrane of egg whereas total nitrogen and crude protein of outer and inner shell membranes are found in the same amount. This can be attributed to the greater absorption of fat in the outer shell membrane. Obviously supply of the fat to the inner shell membrane will be less as the inner shell membrane itself deposit less fat than the outer shell membrane.

#### *Component amino acids :*

Table 4 clearly shows that the total amino acids present are eighteen. Total amino acid contents of the outer shell membrane of egg is higher than the inner shell membrane of

egg. That is why outer shell membrane appear to be strong developed than the inner shell membrane.

Amino acids cystine, histidine, arginine, serine, glycine, glutamic acid, proline, methionine and leucine are present in greater amount whereas lysine, hydroxyproline, aspartic acid, threonine, alanine, tyrosine, valine and phenylalanine are present in less amount in the outer and inner shell membranes of egg. Amino acid isoleucine is found in very small quantity. Amino acids cysteine and tryptophan are absent in the outer and inner shell membranes.

Amino acids cystine, lysine, histidine, arginine, hydroxyproline, serine, glycine, threonine, alanine, isoleucine, leucine and phenylalanine are present in greater amount whereas aspartic acid, glutamic acid, methionine and valine are present in less amount in outer shell membrane than the inner shell membrane. Amino acids tyrosine and proline are present in equal amount in both shell membranes.

#### **Conclusion**

Result of study of the mineral composition of outer and inner shell membranes of partridge are reported. Moisture contents of inner shell membrane is found in greater amount whereas ash contents is found in greater amount in the outer shell membrane therefore mineral constituents calcium is the chief mineral element in the both shell membranes of partridge. Minerals magnesium, phosphorus and sodium are found in traces but the concentration of magnesium and sodium are more in the outer shell membrane than inner shell membrane.

Table 1. Mineral composition of outer shell membrane of egg of Partridge  
(*Francolinus francolinus*)  
(Values are expressed as gram/100 gram of the dry matter)

Moisture	Ash	Minerals	Values	Mineral Oxide	Values	Ash Unaccounted for
15.65	1.60	Ca	0.5966102	CaO	0.8352543	0.7404435
		Mg	0.0062373	MgO	0.0103955	
		P	0.0056949	P <sub>2</sub> O <sub>5</sub>	0.0134316	
		Na	0.0003525	Na <sub>2</sub> O	0.0004751	
				<b>Total</b>	<b>0.8595565</b>	

Table 2. Mineral composition of inner shell membrane of egg of Partridge  
(*Francolinus francolinus*)  
(Values are expressed as gram/100 gram of the dry matter)

Moisture	Ash	Minerals	Values	Mineral Oxide	Values	Ash Unaccounted for
15.82	1.58	Ca	0.5891523	CaO	0.8248132	0.7323337
		Mg	0.0053559	MgO	0.0089265	
		P	0.0058915	P <sub>2</sub> O <sub>5</sub>	0.0134934	
		Na	0.0003214	Na <sub>2</sub> O	0.0004332	
			<b>Total</b>	<b>0.8476663</b>		

Table 3. Crude fat, total nitrogen content and crude protein of outer and inner shell  
membrane of egg of Partridge (*Francolinus francolinus*)  
(Values are expressed as gram/100 gram of the dry matter)

Outer Shell Membrane			Inner Shell Membrane		
Crude fat	Total Nitrogen	Crude protein (Nx6.25)	Crude fat	Total Nitrogen	Crude protein (Nx6.25)
0.65	15.64	97.75	0.64	15.64	97.75

Total of Ash + Crude fat + Crude protein = 100

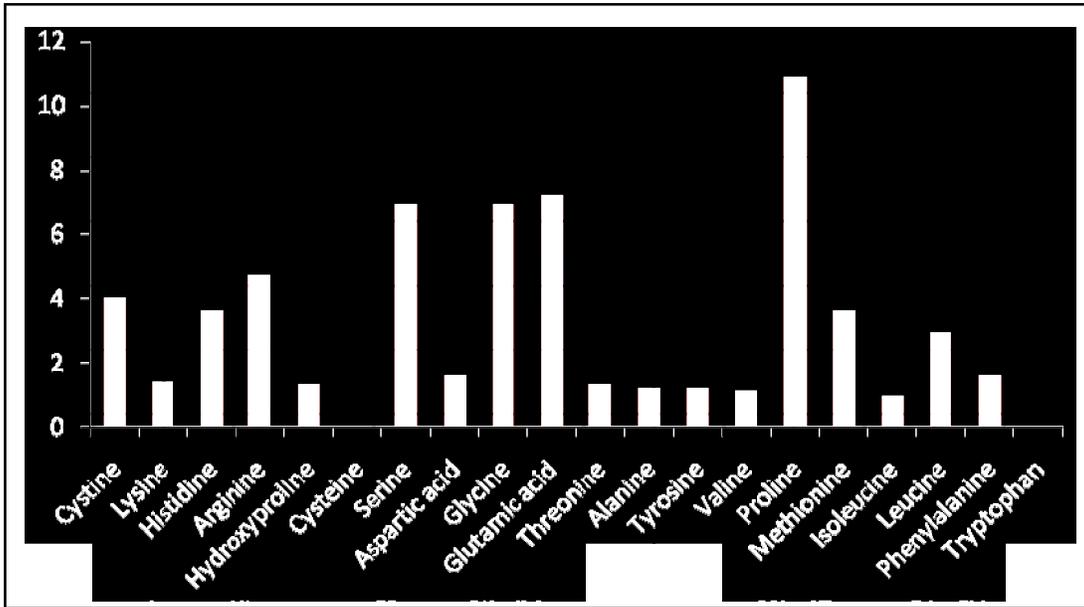
Total of Ash + Crude fat + Crude protein = 99.97

Table 4. Component amino acids of outer and inner shell membrane of egg of Partridge (*Francolinus francolinus*)  
(Values are expressed as gram/100 gram of the dry matter)

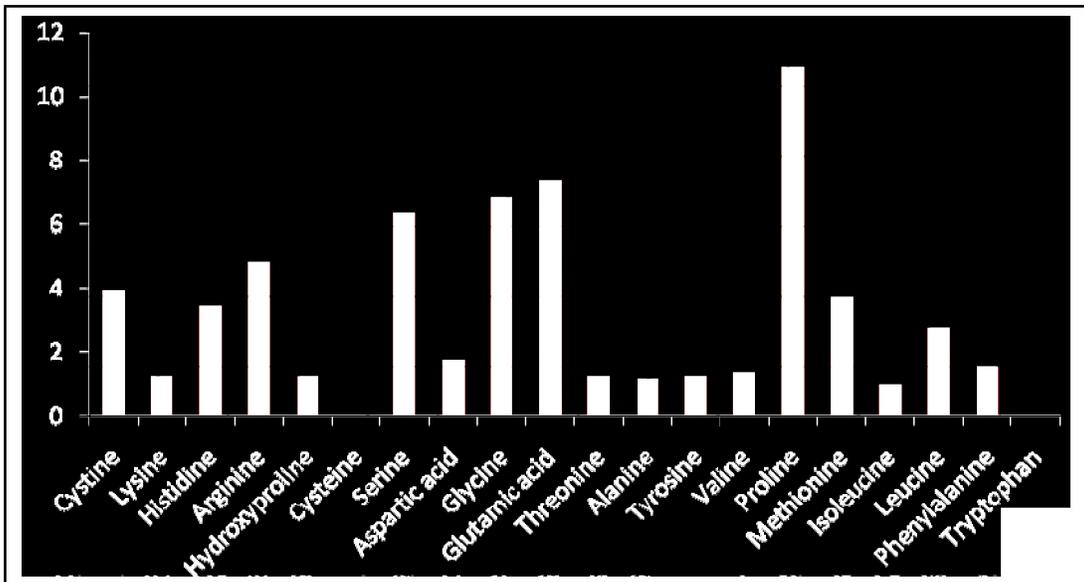
S.No.	Amino acid	Values of outer shell membrane	Values of inner shell membrane
1	Cystine	4.0	3.9
2	Lysine	1.4	1.2
3	Histidine	3.6	3.4
4	Arginine	4.7	4.8
5	Hydroxyproline	1.3	1.2
6	Cysteine	0.0	0.0
7	*Serine	6.9	6.3
8	Aspartic acid	1.6	1.7
9	Glycine	6.9	6.8
10	Glutamic acid	7.2	7.3
11	*Threonine	1.3	1.2
12	Alanine	1.2	1.1
13	Tyrosine	1.2	1.2
14	Valine	1.1	1.3
15	Proline	10.9	10.9
16	Methionine	3.6	3.7
17	Isoleucine	0.95	0.94
18	Leucine	2.92	2.72
19	Phenylalanine	1.6	1.52
20	Tryptophan	0.0	0.0
	<b>Total</b>	<b>62.37</b>	<b>61.18</b>

The shell membrane which consists almost wholly of protein except for very small amounts of water and traces of minerals. Total of ash, crude fat and crude protein of outer shell membrane is found in 100 gram and of inner shell membrane is found in 99.97 gram.

Mineral contents and organic constituents are found in higher amount in outer shell membrane than the inner shell membrane of egg. This can be attributed to the greater absorption of fat in the outer shell membrane. Obviously supply of the fat to the outer shell



Component amino acids of outer shell membrane of egg of Partridge  
(*Francolinus francolinus*)



Component amino acids of inner shell membrane of egg of Partridge  
(*Francolinus francolinus*)

membrane will be higher as the outer shell membrane itself deposit more fat than the inner shell membrane.

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