

Acid Soluble Phosphorus in the Eggs of Fayoumi Fowl During the Embryo Development

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FERTILE eggs of Fayoumi breed were incubated at 37° for a period of 21 days. Inorganic phosphorus, total organic acid soluble phosphorus and barium ethanol soluble phosphorus were determined during different periods of incubation using 8—10 eggs every determination. Acid soluble phosphorus fractions showed considerable changes through the incubation period.

Inorganic phosphorus, barium insoluble organic phosphorus and barium ethanol insoluble phosphorus rise steadily during the incubation period until it reached a maximum at the 21 days old.

The total organic acid soluble phosphorus and barium ethanol soluble phosphorus, rise at the first period of incubation and then fall down by the end of incubation.

The intermediary process of the metabolism of the young embryo attracted the interest of the biochemists because of the peculiar succession of sources of energy which seems to occur during embryonic development. The hen egg provides all the essential nutrients for the embryonic development of the chick to the stage when oral feeding become available.

Needham *et al.* (1937), showed that the main peculiarity in the phosphorus distribution is the extremely high proportion of phosphorus not precipitated by barium.

The major changes in phosphorus distribution during the incubation of the hen egg comprise the disappearance of phospholipid and phosphoprotein phosphorus and the accumulation of inorganic and presumably nucleic acid phosphorus (Plimmer and Scott, 1908 and Massai and Fukutomi, 1923). These changes which involve at least 80% and probably much more of the total phosphorus in the egg, can hardly take place without the intermediate formation of phosphorus compounds of low molecular weight (Jurcenko, 1966 and Reddy and Panda, 1969).

It has therefore been thought worthwhile to examine changes in the acid soluble phosphorus contents during incubation of hen eggs. Some preliminary results are presented.

Material and Methods

Fertile eggs of Fayoumi fowls were obtained from a poultry farm, Ministry of Agriculture. After known period of incubation (Table 1) in an electric incubator at 37°, eggs were chilled in acetone CO₂ stripped of their shells and then they were homogenized in a blender while still frozen.

The cold suspensions were extracted with cold 5% trichloroacetic acid, and the phosphorus in the extracts was fractionated with barium acetate and ethanol at pH 8.3, (The method was modified from Umbreit *et al.* 1965). The estimation of the inorganic phosphorus was carried out colorimetrically according to the method of Fiske and Sabbarow (1925).

Results and Discussion

All Figures reported are means of analyses on 8 - 10 eggs.

Table 1 and Fig. 1 showed the results of average normal embryo at different times of hatching. Figures given revealed that :

Inorganic phosphorus amounts to about 5.1 mg/egg before incubation, rises slowly after the 4th day to 9.8 mg at 12 days and then ever more steeply to 50 - 60 mg at 21 days.

Total organic acid soluble phosphorus starts at about 2.1 mg/egg, rises to a maximum of nearly 2 mg at 16 days (with a sharp increase from 5 to over 8 mg between the 10th and 12th days), and then decreases slightly to 9.5 mg at 20 - 21 days. These values are broadly similar to those of Massai and Fukutomi (1923).

The three barium - ethanol fraction into which the organic acid soluble phosphorus may be divided behave as follows:

1. Barium insoluble organic phosphorus remains fairly constant at about 0.7-0.9 mg/egg for 8 days and then rises steadily to 4.5 mg at 21 days.

This fraction is composed of adenosine triphosphate (ATP), adenosine diphosphate (ADP), fructose 1 : 6 diphosphate and 3- phosphoglyceric acid (Umbreit *et al.*, 1965).

2. Barium ethanol insoluble phosphorus begins to rise from 0.6 mg egg at 4 days until it reaches a final value of 4.0 mg at 21 days. No further investigations have yet been made for this fraction. Umbreit *et al.* (1965) demonstrated that this fraction of acid soluble phosphorus composed of glucose-1-phosphate, glucose - 6 - phosphate, fructose - 6 - phosphate, phosphopyruvic acid, ribose-5 - phosphate, dihydroxy acetone phosphate, adenylic acid and phosphocreatine.

3. Barium ethanol soluble phosphorus which varies during the first 4 days from zero to 1.3 mg / egg, rises to nearly 2 mg at 10 days, and then to 4.4 mg at 12 days, thus accounting for the sharp jump in the total organic

TABLE I. Changes in the acid soluble phosphorus compounds during development of eggs embryo.

Days	mg of P/egg				
	Inorg.P	Total org. acid sol. P	Ea insol. org.P	Ea ethanol Insol. P	Ea ethanol Sol. P
Before incubation	5.1	2.1	0.70	0.6	0
1 st after incubation	5.2	2.2	0.71	0.6	1.0
2 nd	5.2	2.2	0.75	0.61	0.8
3 rd	5.21	2.4	0.71	0.6	0.52
4 th	5.20	3.0	0.81	0.6	1.3
5 th	5.5	3.6	0.89	0.8	1.33
6 th	5.9	3.9	0.88	0.99	1.6
7 th	6.4	4.2	0.91	1.2	1.8
8 th	6.8	4.5	0.89	1.4	1.9
9 th	7.5	4.9	1.12	1.45	1.98
10 th	8.2	5.0	1.4	1.6	1.9
11 th	9.1	7.1	2.1	2.0	3.2
12 th	9.8	8.5	2.8	2.1	4.4
13	12.1	9.1	2.9	2.1	3.6
14	17.2	9.8	3.1	2.4	3.1
15	23.5	10.2	3.5	2.8	2.8
16	30.2	11.1	3.9	3.1	2.3
17	39.4	11.0	3.91	3.1	2.0
18	42.9	10.5	4.10	5.5	1.9
19	48.5	10.1	4.41	3.8	1.5
20	54.1	9.5	4.45	3.99	1.3
21	58.2	9.5	4.50	4.0	1.0

acid soluble phosphorus seen at the same period, after this there is a steady fall until at 21 days, where the figure is only about 1 mg / egg. Since the quantity of this fraction is not decreased by carrying out the barium-ethanol precipitation at pH 12 instead of pH 8.3, it does not seem to contain much ethyl phosphate (Outhouse, 1936).

The increased phosphorylated carbohydrate intermediates in egg embryo during incubation might promote the activities of related enzymes to increase and remained high until the day of hatching. This postulation confirmed with the work of Kushuhara and Ishida (1974), which indicated that the activities of glucose-6-phosphatase, acid phosphatase and glyceraldehyde - 3 - phosphate dehydrogenase (6 - 3 - PDH) were increased when chick embryos were incubated for 12 days.

That phosphorylated carbohydrate intermediates and relate compounds play indispensable roles in intermediary metabolism of egg embryo. Further experiments are needed to throw more light on this problem.

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مكونات الفوسفور الذائب في الحمض في بيض الدجاج الفيومي أثناء نمو الجنين

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حظن بيض دجاج فيومي مخضب لمدة ٢١ يوما على درجة ٢٧° م . قدرت كل من مكونات الفوسفور الغير عضوى ، والفوسفور العضوى الكلى الذائب في الحمض ، والفوسفور العضوى الغير ذائب في الباريوم ، والفوسفور الغير ذائب في الباريوم وكحول الايثايل ، والفوسفور الذائب في الباريوم وكحول الايثايل - أثناء فترات مختلفة من التحضين حيث استخدم من ٨ - ١٠ بيضات كل مرة .

وقد وجد تغير واضح في محتوى البيض من الفوسفور الذائب في الحمض خلال مدة التحضين حيث ارتفعت تدريجيا مكونات الفوسفور الغير عضوى ، والفوسفور العضوى الغير ذائب في الباريوم وكحول الايثايل - خلال فترة التحضين حتى وصلت أعلى قيمة في نهاية فترة التحضين (٢١ يوم) .

أما مكونات الفوسفور العضوى الكلى الذائب في الحمض ، والفوسفور الذائب في الباريوم وكحول الايثايل - فقد ارتفعت في بداية فترة التحضين ثم انخفضت في نهاية المدة .