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Plasma Iron Turnover and Egg Production in Hens

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The laying period in birds produces an increase in the plasma iron turnover that is proportional to the egg production. A rise in the plasma iron values and a longer clearance rate is the characteristic modification of the iron metabolism in this state. The copper metabolism is also modified during the laying period with higher plasma values but the levels remain practically constant at different laying frequencies. The iron and copper contents in eggs were independent from the egg production.

The need of iron for the egg formation increases in the laying period and for this reason a high activation in the iron metabolism is produced (4, 8, 11).

The plasma iron turnover (PIT) has been determined in fowl (9, 12) and also in duck and turkey (2). In all the species analyzed, the PIT values significatively increased during the laying state.

A relationship between the serum levels and the different percentage of egg production was not evident (5). In the present work, this problem has been reanalyzed with a greater number of animals for group in which the PIT has been also determined so that the change in the iron metabolism during the laying period could be made more evident.

Materials and Methods

29 white Leghorn laying hens of a Hy-Line strand have been kept in individual cages and there was a daily laying control during a three months period. At the end of this period the hens were clasified in three groups according to the laying percentages: *a*) 7-26 %; *b*) 40-52 %, and *c*) 58-69 %.

The plasma iron turnover was determined with Fe-59 (5 μc/kg b.w.) following BOTHWELL and FINCH (3) with the same modification that has been used in previous papers (2, 9).

The iron and copper in plasma and in the whole egg has been determined by

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atomic absorption spectroscopy with an acetilen/air flame in an apparatus Evans, Mod. 240, according to a method adapted from SPRAGUE and SLUVIAN (13). The samples were obtained by acid digestion. The standard solution were prepared from the Titrisol (Merck).

Results

The increased percentage of laying produces some rise in the PIT values, but not statiscally significant (Table I).

A progressive increase in plasma iron and at the same time in the clearance time (T ½ values) can explain this fact. On the other side, the plasma copper is also high, but does not differ among the groups. The blood and plasma volumes increase with the laying frequency owing to the age and body weight, but the hematocrit values remains constant.

In Figure 1 can be seen the rates in which the Fe-59 disappear from the plasma, compared with the rate of the non-laying hens and pullets. It is clear that the lowest rates correspond to the highest rates of laying.

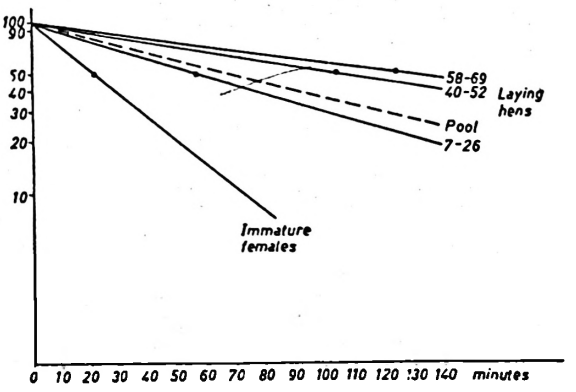

Fig. 1. *Fe-59 plasma clearance rates from the three groups of laying hens clasified according to the procentage of egg production. A) 7-26 %; B) 40-52 %; C) 58-69 %.* For comparition data from immature females (n = 7, PIT = 2,939 ± 975 μg Fe/100 ml/24 h) and laying hens without egg control (Pool) (n = 16, PIT = 5,532 ± 2,167 μg Fe/100 ml/24 h) published previously (9) are included. It is clear the proportional enlargement of the iron clearance rate in higher laying frequencies.

The iron and the copper content in the eggs (Table I) do not present any significative variation among these groups.

Tabla I. *Copper (Cu), iron (Fe) and plasma iron turnover (PIT) in three groups of hens with different Egg production checken during a 3 month period.*
The clearance time (T ½) and blood and plasma volume are also included. The Fe and Cu content in the whole egg have been analyzed in each group. m ± σ.

Group Laying rate No.	Cu μg Cu/ 100 ml	Fe μg Fe/ 100 ml	T (½) mim.	PIT μg Fe/100 ml/ 24 h	Volume (ml) Blood	Volume (ml) Plasma	Hemat. %	Whole Egg mg Fe/ 100 g egg	Whole Egg mg Cu/ 100 g egg
Group I 7-26 % N = 9	89±38	355±132	57±27	5,611±855	122±15	87±16	30±2	1,14±0,3 N = 29	0,10±0,04 N = 29
Group II 40-52 % N = 9	69±35	613±109	104±24	5,817±550	139±21	98±32	30±2	1,12±0,2 N = 29	0,13±0,06 N = 29
Group III 58-69 % N = 11	82±41	733±148	124±23	6,393±1,236	153±25	108±18	30±1	1,25±0,4 N = 46	0,14±0,07 N = 46

Discussion

The plasma iron turnover (PIT) in hens passes from 2,900 ± 975 μg Fe/100 ml/24 h in immature pullets to 5,532 ± 2,167 in laying hens (9). In other species as turkeys and ducks (2) the PIT values during laying are also approximately the double as the values of adult non-laying females, the absolute values also being very similar (4,800 and 6,600 μg Fe/100 ml/24 h respectivelly).

The egg production in all kind of the studied birds produces a proporcional modification in the iron metabolism. This is characterized by an increase of the plasma iron and a longer clearance rate which produces a increase in the PIT values.

The copper metabolism is also modified during the laying period. It has been checked (1) the parallel increase of iron and copper in plasma in turkeys and hens. This fact was also obtained experimentally by the injection of estrogen to immature pullets.

There are several reasons to consider the estrogen as the primary cause of the modification in the iron and copper metabolism. It is known that during the sexual maturity and in the laying period exist a rised production of estrogens. Recently one of us (10) has found that the estrogen injection induces the production of a ferroxidase (ceruloplasmin; a copper-enzyme) which mobilize the iron from the liver stores (6, 7).

In a previous paper (5) the correlation between iron and copper in plasma and in eggs has been found but the values were independent from the percentage of the egg production. In the present work, it can be appreciated that the copper plasma levels remains practically constant at different laying frequencies, but the plasma iron increases progressively. In the eggs a variation in metal content does not exist. The variation in plasma iron and in the clearance time in the same direction produces a compensation and so the progressive increase in the PIT values, though observed, is not significant.

References

1. BALASCH, J., BRASO, A. and PLANAS, J.: *Actas Soc. Esp. Cien. Fisiol.*, 353-356, Santiago, 1970.
2. BALASCH, J. and PLANAS, J.: *R. esp. Fisiol.*, 28, 125, 1972.
3. BOTHWELL, T. H. and FINCH, C. A.: Iron Metabolism. Little, Brown and Co., Boston, 1962.
4. HALKETT, J. A. E., PETERS, T. and ROSS, J. E.: *J. Biol. Chem.*, 231, 187, 1958.
5. LATORRE, J. L., RECIO, J. M. and PLANAS, J.: *R. esp. Fisiol.*, 28, 65, 1972.
6. OSAKI, G., JOHNSON, D. A. and FRIEDEN, E.: *J. Biol. Chem.*, 241, 2746, 1966.
7. OSAKI, G., JOHNSON, D. A. and FRIEDEN, E.: *J. Biol. Chem.*, 246, 3018, 1971.
8. PLANAS, J., CASTRO, S. and RECIO, J. M.: *Nature*, 189, 668, 1961.
9. PLANAS, J. and BALASCH, J.: *R. esp. Fisiol.*, 26, 307, 1970.
10. PLANAS, J. and FRIEDEN, E.: *Am. J. Physiol.* (In press.)
11. RAMSAY, W. N. M. and CAMPBELL, E. A.: *Biochem. J.*, 58, 313, 1954.
12. RUSOV, C.: *Med. Landbouw. Zoek. Staat Gen.*, 30, 787, 1965.
13. SPRAGUE, S. and SLAVIN, W.: *Atomic Absorption Newsletters*, 4, 228, 1965.