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CALCIUM DISTRIBUTION IN CHICKEN BLOOD

Henry Paul, Stillwater

In an attempt to explain why the total calcium of the blood serum of animals remains quite constant even in the presence of certain diseases closely related to calcium metabolism, investigators have made studies of the various forms of calcium in the blood.

It is now recognized that calcium exists in serum in at least three distinct forms. One fraction is not filterable through semi-permeable membranes and is considered to be bound to the serum proteins. For this reason, it is referred to as "Protein-bound calcium," and constitutes about 30 per cent of the total calcium of the blood serum. A second fraction termed "Ionic calcium" comprises about 20 per cent of the serum calcium.

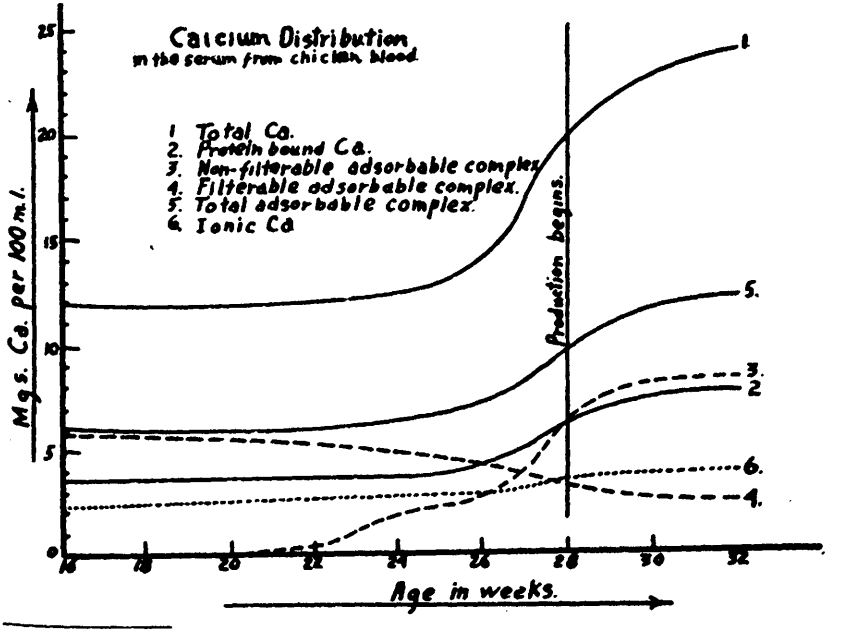
The remaining 50 per cent of the calcium seems to exist in the form of a complex. The fact that it is termed a complex indicates our lack of knowledge as to its structure. However, it is known that this fraction migrates towards an anode and therefore must be part of a negatively charged molecule. Furthermore, this complex is readily absorbed by positive absorbants such as $BaSO_4$ and $(Ca_3PO_4)_2$ and is therefore termed "Adsorbable calcium." It can be further sub-divided into two distinct forms, one of which evidently consists of complex particles of large size as they are non-filterable, and the other consists of simpler complex particles of filterable size. These two forms are termed "Non-filterable adsorbable calcium" and "Filterable adsorbable calcium," respectively.

Although the total calcium of the blood serum of mammals tends to remain constant, we find that in the case of chickens the total calcium varies from 10 to 25 mgs. per 100 ml. of serum, the high values always being found during periods of egg production. This wide variation is not so surprising when the large amount of calcium that must be metabolized by the bird in egg shell formation is considered.

This investigation was undertaken to determine just what changes take place among the various fractions of blood calcium during the transition period from a non-laying to a laying hen. This information may be of value in later studies of "perosis" in chickens, or of other conditions which might be suspected to result from calcium abnormalities.

DISCUSSION AND RESULTS

The calcium distribution of the serum of chickens was determined at two week intervals by methods suggested by Benjamin and Hess*. The samples were obtained by heart puncture from healthy White Leghorn pullets of the same age. The results are recorded in the following graph.



*Benjamin, H. R., and Hess, Alfred F J. Biol. Chem., 100, 27 (1933).

It is apparent that the total calcium of the blood varies from 12 mg. per 100 ml. serum for non-laying hens to 24 mg. for laying hens. Two weeks after production had started the total calcium was still rising, although slowly, as is illustrated by Curve No. 1 on the graph. Curves 2 and 5 show this same general trend for the protein-bound calcium and the total adsorbable calcium. However, when the total adsorbable calcium is divided into its two components, the non-filterable adsorbable calcium (Curve 3) and the filterable adsorbable calcium (Curve 4), it is found that marked changes are taking place. The non-filterable adsorbable complex is not present in significant quantities in the young hen, but makes its appearance about eight weeks before egg production begins, at which time about 2 mg. per 100 ml. are present. At production this value ascends rapidly to over 8 mg. The converse is true of the filterable adsorbable calcium, the degree of variation being much less, which drops from 6 mg. to less than 4 mg. per 100 ml. (Curve 4). Curve 6 shows only a slightly upward trend for the ionic calcium with values varying from 2 to 4 mg.

From these results it appears that the non-filterable adsorbable complex form of calcium is the most closely associated with the process of egg shell formation, and it is this fraction which may be considered to be the physiologically active one as it furnishes either directly or indirectly the largest portion of the calcium so necessary for egg production.

This work is being carried on through the growing, producing, moulting and back to producing stages in order to obtain a complete set of data for the entire life cycle of the hen.

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