CALCIUM REQUIREMENTS AS AFFECTED BY OTHER NUTRIENTS IN THE RATIONS OF LAYING HENS

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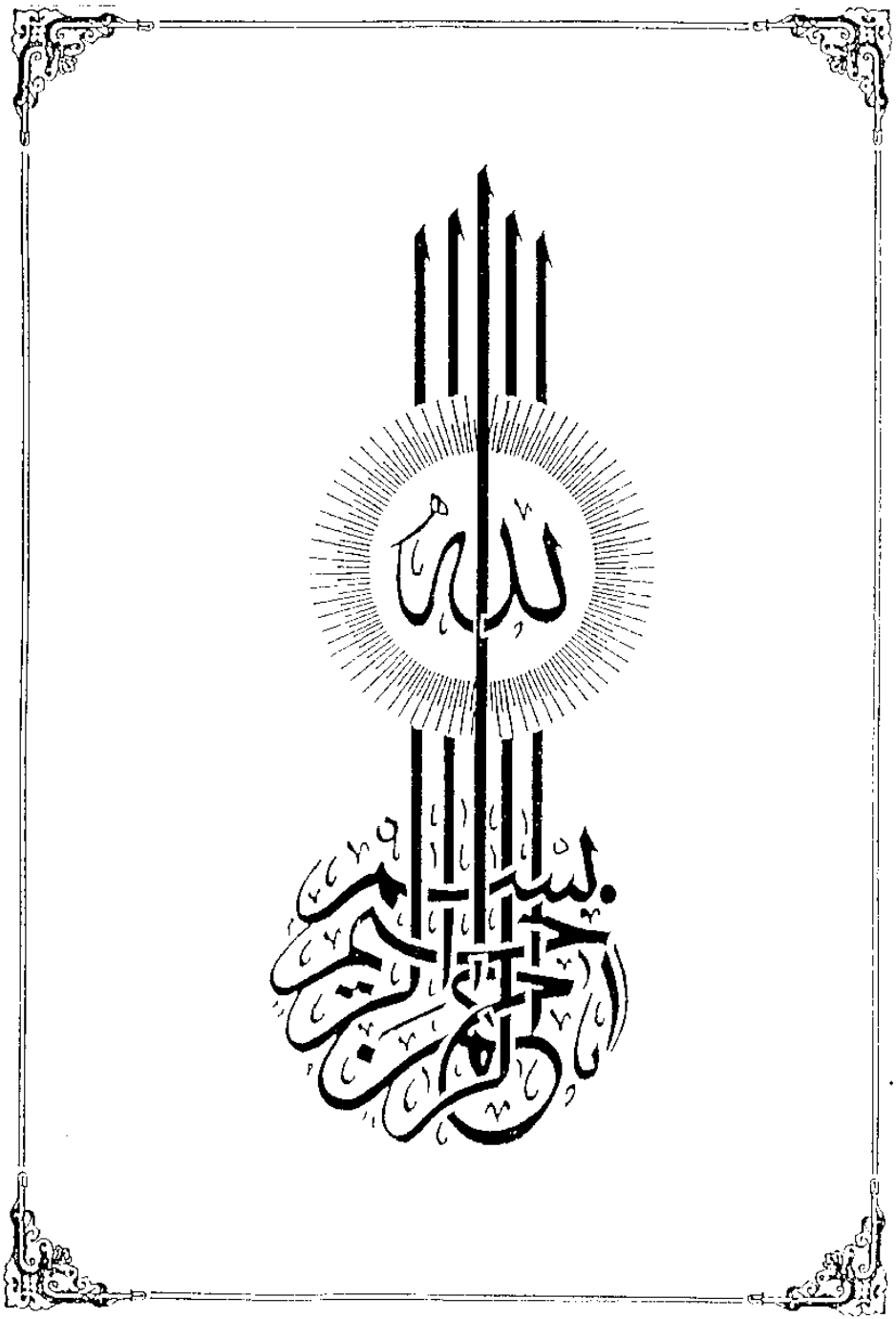

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CHAPTER I

I. INTRODUCTION

Published data on calcium requirements and its interrelationship with other nutrients in the ration of laying hens are numerous, though they are rather scarce in Egypt.

It is obvious that the chief guide to the requirements for egg production is the composition of the egg itself. A marked deficiency of any essential component in the ration of the hen will be reflected on the yield of egg production. Calcium is one of the major nutrients required in ample quantities for normal egg production; it is particularly needed for proper shell formation. Calcium requirement for laying hens depends on (1) the number of eggs laid (2) the quantity of feed consumed, and (3) the phosphorus content of the laying ration.

The ever-increasing demand for eggs of high quality is considered a feature of our modern life. New hybrids of breeds, strains and inbred lines, all contributed in the higher production of eggs required to cover these needs. The main trouble between the producer, the dealer and the consumer lies on the delivery of eggs with shells of poor quality

which do not tolerate the hazards of handling.

On the other hand, it is well known that the egg shell quality tends to deteriorate in the hot weather and aging of hens.

Due to the mentioned factors that are markedly affecting egg production, it seemed of great importance to investigate calcium requirements for Fayoumi laying hens, as an indigenous breed, and the main nutritional factors affecting such requirements, as calcium sources, phosphorus contents, ascorbic acid (vitamin C) and vitamin D_3. Performance of egg production and egg shell quality were also involved.

2. REVIEW OF LITERATURE

The functions of the minerals in the animal body are numerous. Compounds of these elements are found in all tissues. In the absence of certain mineral elements, the various organs and tissues of the animal organism are unable to perform their functions.

Calcium in the form of calcium carbonate, is the chief constituent of egg shell; calcium and phosphorus are characteristic constituents of the bones; iron is an indispensable constituent of the hemoglobin of the blood; iodine is an essential constituent of thyroxine hormone; compounds of sodium and potassium together with other mineral elements are necessary for maintaining the acid-base equilibrium of the body; the chlorine is an important constituent of the secretion of the proventriculus. Calcium also plays an important role in blood clotting; minute traces of copper are required by the animal to enable it to utilize iron in the formation of hemoglobin; manganese and zinc are essential for reproduction and normal bone development; and cobalt, in the form of vitamin B_{12}, is necessary for the maturing of the red cells. Also, there is good evidence that several

of the mineral elements are essential constituents of enzymes or of enzyme systems (Titus and Fritz, 1971).

The chicken requires, for normal nutrition: calcium, phosphorus, potasium, sulphur, sedium, chlorine, magnesium, iron, copper, manganese, iodine, zinc and cobalt, A number of other mineral elements are probably required such as molybdenum, selenium and flourine.

Of the mineral elements named: calcium, phosphorus, manganese, sodium, chlorine and zinc must ordinarily added to practical poultry feeds. At times, other mineral elements may be present in suboptimal quantities.

The animal requirements for minerals may be exprcssed as amounts per day or percent of product such as milk or eggs or as proportion of the ration used. The first way is more precise but the latter is simpler and has obvious practical advantages (Underwood, 1966).

Many factors affect the mineral requirements of animals, the most important of which are: (a) the species or the breed (b) the age, sex and rate of growth (c) the nature and the rate of production (d) the level and the chemical forms in

which the mineral is ingested (e) the overall balance and adequacy of the diet in relation to the purpose of which it is given (f) hormonal and physiological activities within the animal (g) the climate and (h) the criteria of adequacy employed. These factors do not act independently of each other. They are, in fact, closely interrelated and interdependent, so that one component of the ration or the animal or the environment may be acting in a manner which would raise the requirement of a particular mineral nutrient while at the same time other factors are tending to reduce the requirements (Underwood, 1966).

In relation to the scope of the present study, the calcium requirements for laying hens and its relation to other dietary factors are investigated.

1. Effect of dietary calcium level on :

a - Egg production :

Calcium level in laying rations has been studied by several investigators, and a great deal of research have been conducted on the Ca requirement for layers under different environmental and nutritional conditions. The National

Research Council (N.R.C., 1971) recommended 2.75% total dietary Ca for egg production, but not necessarily incorporated in the ration.

Variable values for Ca requirement were reported in the literature. Mostert (1960) reported that hens in batteries required 2.5 to 3.5% Ca in all mash rations, for maximum egg production. Hurwitz and Griminger (1960) showed that hens fed a ration containing 2.79% Ca produced significantly more eggs than those fed a ration with 1.85% Ca. Sullivan and Kingan (1962) reported that increasing dietary Ca level from 1.6 to 2.8% increased hen day egg production rate from 54.4 to 73.9%. Hurwitz and Griminger (1962) stated that the daily Ca requirements for hens with 80% egg production was about 3 g. The results of Hunt et al. (1961) showed that as dietary Ca level increased from 1.75 to 2.25%, egg production increased. Anderson (1967) found that total number of eggs laid per bird was more with more Ca in the rearing ration up to 2.5%.

Hulan and Nikolaiczuk (1972) studied the effect of summer temperatures on egg production in Quebec (Canada) and concluded that a ration with 2.66 or 2.75% Ca was sufficient

for 75 to 80% egg production.

Kubota and Morimoto (1966) indicated that in cages, the ration should have 2.75% dietary Ca to maintain best egg production. The corresponding value was 3.2% for birds reared on deep litter.

De Groote and Reyntens (1968) with rations containing 2.26, 3.28 or 4.30% Ca found that the best requirement for Ca was approximately 3.28%. They also added that 4.30% Ca did not increase the rate of laying.

Several workers studied the influence of feeding laying hens on rations containing different levels of dietary Ca ranged between 1.5 and 4.5% and reported that as the dietary Ca level increased, the rate of egg production increased (Pepper et al., 1961; MacIntyre et al., 1964; Hurwitz and Bornstein, 1964; Furuta et al., 1965; Riddy et al., 1968; Quisenberry et al., 1969 and Miller and Sunde, 1975).

Mostert (1964) found that egg production was less with 3.5% dietary Ca level than with 5.0%. The same result was obtained by Scott et al. (1971), while Hull and Scott