Egypt. J. Anim. Prod. 20, No. 2, pp. 189-194 (1980)

Serum Alkaline Phosphatase in Fayoumi and White Leghorn Hens as Related to Egg Production and Dietary Protein

M.F. Ali and F.M. Attia

Faculty of Agriculture, Ain-Shams and Al-Azhar Universities, Egypt.

Serum alkaline phosphatase was evaluated in Fayoumi and White Leghorn hens fed isocaloric diets containing 14.85 and 18.56 % dietary protein.

Results indicated that the White Leghorn hens had a higher level of serum alkaline phosphatase than the Fayoumi hens, irrespective of the dietary protein level. In the meantime the White Leghorn hens fed the high dietary protein level showed a pronounced increase in serum alkaline phosphatase which was coupled with 98% increases in egg production over those fed the low protein diet. In the Fayoumi breed no such response either in serum alkaline phosphatase or egg production was noticed. In fact both varibles were almost constant for the two levels of dietary protein and much lower than their counterparts in the White Leghorns. Thus it may be suggested that serum alkaline phosphatase is a reliable measure for high egg production.

Several reports indicate that the alkaline phosphatase level in blood is lower in adult than in growing birds (Bell, 1960; Tanabe and Wilcox, 1960 and Choudhary, Krishna, Vernia and Shivaprasad, 1971).

Alkaline phosphatase level in the hen was found to be significantly and positively correlated with egg production and other traits such as body weight (Gutowska, Parkhurst, Parrot and Verburg, 1943; Stutts, Briles and Kunkel, 1957).

Literature pertaining to the effect of dietary protein on alkaline phosphatase is lacking.

The purpose of this study was (1) to differentiate between Fayoumi and White Leghorn chickens with respect to egg production and alkaline phosphatase level and (2) to determine the effect of feeding high and low levels of dietary protein on serum alkaline phosphatase of Fayoumi and White Leghorn chickens.

Material and Methods

A total of 72 laying hens of Fayoumi and White Leghorn breeds were used in this study .

The hens were taken at random from a population of more than 500 hens. Hens were kept indicidually in batteries. Each breed was divided into two groups. One group was fed 14.85 % protein laying ration while the other group was given a 18.56 % protein . The productive energy for both rations was the same (880.7 Kcal/lb). Blood samples were taken by heart puncture from each bird. After clotting, the blood samples were incubated at 37° for two hours to permit adequate separation of the serum, which was then decanted and frozen at -15° until they were analysed.

The serum was analysed photometrically for alkaline phosphatase according to the method of Bessey *et al.* (1946)

Eggs were collected and recorded daily for each hen of the two breeds.

Results and Discussion

Table 1 shows the analysis of variance for alkaline phosphatase level in Fayoumi and White Leghorn breeds maintained on high and low protein rations along with their interactions. In general the high egg producing White Leghorn was characterized by the presence of high serum alkaline phosphatase regardless of dietary protein level. This was in agreement with the results reported by Gutowska *et al.* (1943) and Wilcox (1963).

TABLE 1 **Analysis of variance of alkaline phosphatase levels in Fayoumi and White Leghorn hens fed on two different rations.**

S.O.V	D.F.	S.S.	M.S.	F.
Total	71	8246.18		
Breeds	1	824.18	824.18	8.58**
Rrations	1	401.39	401.39	4.18*
Breeds × Rations. . .	1	488.81	488.81	5.09*
Exp.error	68	6531.80	96.06	

* Significant at 5 % level of probbaility.

** Significant at 1 % level of probability.

It is noticed that dietary protein level had marked effect on the level of serum alkaline phsophatase. The difference between high and low dietary protein is shown in Tabe 2 for each breed.

TABLE 2. Average alkaline phosphatase levels (mM nitrophenol/L/hr) in Fayoumi and White Leghorn hens fed on two different dietary protein levels

Protein level	Fayoumi	White Leghorn	Av. Alkaline phospha tase level
Low.	18.70	20.26	19.48
High	18.21	30.19	24.20*
Av. Breed . . .	18.45	25.22**	

The interaction between breeds and dietary protein was also found to be significant ($P< 0.05$).

It is of interest to note that the White Leghron hens showed a relatively sharp increase in serum alkaline phosphatase in the high dietary protein ration over the low one Table 2. In the Fayoumi breed such response in serum alkaline phosphatase was not observed Table 3.

TABLE 3. Analysis of variance of averageegg production in Fayoumi and whiteleghorn fed onttwo different rations

S.O.V	D.F	S.S	M.S	F.
Total	55	77.71		
Breeds	1	147.71	147.71	16.88**
Rations	1	74.98	74.98	8.57**
Breeds × Rations . . .	1	100.12	100.12	11.44**
Exp. error	52	454.90	8.75	

** Significant at 1 % level of probability.

Table 3 shows the analysis of variance for egg production in Fayoumi and White Leghorn breeds fed on low and high protein rations along with their interaction. Highly significant difference was found between Fayoumi and White Leghorn breeds. Diteary protein levels were shown to have a highly significant effect on the egg production. The interaction between the breeds and levels of dietary protein was also highly significant.

It was noted that White Leghorn breed gave relatively substantial increase (98%) in egg production with high level of dietary protein over the low one (Table 4). No such observation was found in Fayoumi. This suggests that serum alkaline phosphatase is a reliable index for high egg producing breeds. This was confirmed by a regression analysis and particularly at the low dietary protein level for either the Fayoumi or White Leghorn breed. The regression coefficient ($b = 0.1948$) (corresponding to a correlation coefficient $r = 0.480$) between the level of serum alkaline phosphatase and egg production for White Leghorns fed the low protein ration was significant ($P< .05$).

TABLE 4. Egg production as percent in Fayoumi and White Leghorn hens fed on two different dietary proteins

Dietary Protein	Fayoumi	White Leghorn
Low	100	100
High	98*	198*

* Expressed as percent of the low protein ration for the same breed.

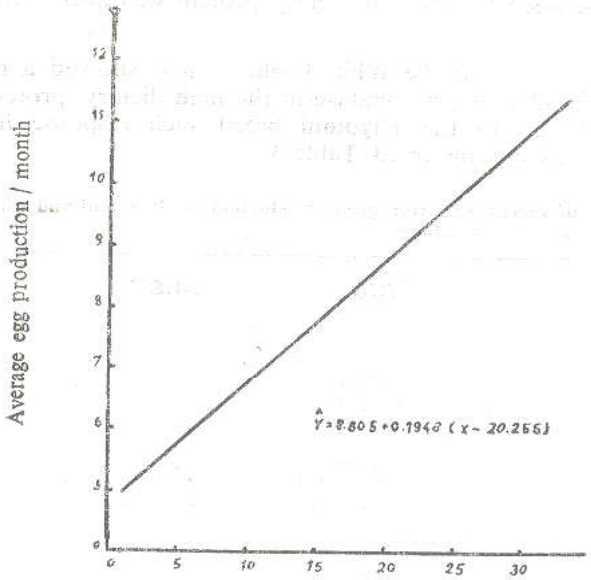

Fig. 1. Alkaline phosphatase level (mM nitrophenol/L./hr) Regression line egg production (egg numcer per month) on alkaline phosphatase is Fayoumt hens.

The regression of alkaline phosphatase to egg production in White Leghorns is shown graphically in Fig. 1. A regression line was fitted to the data by the least squares method giving :

$Y = 8.805 + 0.1948 (X - 20.255)$.

Where : Y is expected egg production.

X is alkaline phosphatase level (mM nitrophenol /L/hr).

In Fayoumi hens fed low protein diet, the regression coefficient ($b = 0.2135$) between serum alkaline phosphatase lvel and egg production was significant ($P<.05$). The intensity of this relationship was quite high as shown by the positively significant correlation corefficient ($r = 0.5196$). The regression of alkaline phosphatase to average egg number per month is shown

Graphically in Fig. 2. The regression line fitted to the data was :
$Y = 4.361 + 0.2135 (X - 18.700)$.

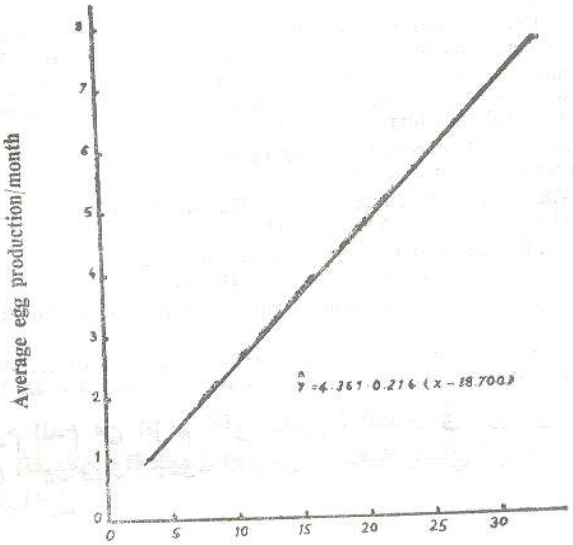

Fig. 2, Alkaline phosphatase level (mM nitrophenol/L./ hr) Regression line egg prodection (egg number per month) on alkaline phosphatase in Fayoumi hens.

However the situation was quite different at the high dietary protein level with regard to the regression analysis either for Fayoumi or White Leghorn breed. In the White Leghorns the regression coefficient for the alkaline phosphatase and egg production was insignificant ($b = -0.053$). This along with a quite low correlation coefficient ($r = 0.008$) indicated complete lack of association in this respect. The same trend was observed with regard to the Fayoumi breed at the high dietary protein where ($b = 0.066$) and ($r = 0.031$) are insignificant.

Such lack of association between alkaline phosphatase and egg production at the high dietary protein could be attributed to the fact that rate of alkaline phosphatase synthesis is dependent on the level of amino acid pool blood. The low dietary protein level apparently only provides the threshold level of amino acids which is just enough for synthesis of the minimum cell requirements of alkaline phosphatase and therefore the strong relationship between alkaline phosphatase and egg production was unmasked. However, at the higher dietary pvotein level the presence of excess amounts of amino acids could have triggered the production of much higher amounts of alkaline phosphatase which led to the confounding of the relationship between the enzyme serum alkaline phosphatase and egg production.

However while such hypothesis applies only for White Leghorn, it was not applicable to Fayoumi. Such discrepancy might be attributed to breed difference.

References

Bell, D.F. (1960) Tissue components of the domestic fowl. 4. Plasma-alkaline-phosphatase activity. *Biochem. J.* 75,224.

Bessey, O.H., Loury and Brock M.J. (1946) A method for the rapid determination of alkaline phosphatase with five cubic millimeters of serum. *J. Biol. Chem.* 164,321.

Choudary, R P , Krishna, Vetina, S.K., Shivaprasad, H. L. (1971) Serum alkaline phosphatase polymorphism and its association with economic traits in White Leghorn . *Indian J. Poultry Sci.* (Animal Breeding Abstract 1973,3244).

Gutowska, M.S., Parkhurst, R.T. Parrot, E.M., and Verburg R.M., (1943) Alkaline phosphatase and egg formation. *Poultry Sci.* 22, 195.

Stutts, E.C., Briles W.E., and Kunkel. H.O. (1957) Plamsa aikaline phosphatase activity in mature in bred chickens. *Poultry Sci.*, 36, 269.

Tanabe, Y., and Wilcox. F.H., (1960) Effects of age, sex and line on serum alkaline phosphatase of the chicken. *Proc. Soc. Exp. Biol. Med.* 103, 68.

Wilcox. F.H., (1963) Genetic control of serum alkaline phosphatase in the chicken. *J. Exp. Zool,* 152, 195.

Wilcox ,F.H., Van Vleck L.D. and Harvery W.R., (1963) Estimates of correlation between serum alkaline phosphatase level and productive traits. *Poultry Sci.* 42, 1457.

محتوى سيرم الدم من انزيم الفوسفاتيز القاعدى فى كل من اناث الدجاج الفيومى واللجهون الأبيض وعلاقته بانتاج البيض والبروتين المأكول

مى فؤاد على وفؤاد محمد عطيه

أستاذ مساعد فسيولوجيا الدواجن بزراعة عين شمس ، أستاذ مساعد تغذية الدواجن بزراعة الأزهر

تم تقدير محتوى سيرم الدم من أنزيم الفوسفاتيز القاعدى فى كل من اناث الدجاج الفيومى وكذلك اللجهورن الأبيض التى غذيت على علائق متوازنة الطاقة تحتوى على ١٤ر٨٥٪ و ١٨ر٥٦٪ بروتين •

أظهرت نتائج هـذه الدراسـة أن محتوى سـيرم الدم من أنزيم الفوسفاتيز القاعدى كان أعلى فى اناث اللجهورن الأبيض عن اناث الفيومى بغض النظر عن مستوى البروتين فى العليقـة • فى نفس الوقت أظهرت اناث اللجهورن الأبيض التى غذيت على المستوى العالى من البروتين زيادة واضحة فى نشاط أنزيم الفوسفاتيز القاعدى لسيرم الدم وكانت هذه الزيادة مصحوبة بزيادة حوالى ٣٣٪ فى انتاج البيض عن المجموعة التى غذيت على المستوى المنخفض من البروتين • لم يلاحظ أى تاثير لمستوى البروتين على نشاط الفوسفاتيز القاعدى وكذلك انتاج البيض فى النوع الفيومى • فى الحقيقة فان هـذين المتغيرين يرتبطان دائما بمستويات البروتين المـأكول وكانا أقل بكثير عن مثيلاهما فى اللجهورن الأبيض • بذلك يمكن استنتاج أن نشاط أنزيم الفوسفاتيز القاعدى سيرم الدم يعتبر مقياس يركن الاعتماد عليه فى حالة انتاج البيض العالى •

مستوى أنزيم الفوسفاتيز القاعدى فى سيرم الدم كان عاليا فى الطيور صغيرة العمر وازداد ارتفاعا عند بداية وضع البيض • بالرغم من ذلك فان هـذا المستوى المرتفع لأنزيم الفوسفاتيز القاعدى المنخفض عندما توقفت الطيور عن وضع البيض • عامة فان الطيور ذات الانتاج العالى من البيض تتميز بارتفاع محتوى سيرم الدم من هذا الانزيم عن تلك منخفضة الانتاج •