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# Effect of Vitamin E on Production Performance and Egg Quality Traits in Indian Native Kadaknath Hen

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**ABSTRACT :** This experiment investigated the effects of increasing dietary vitamin E (VE) on production performance and egg quality traits of Indian reared Kadaknath (KN) hens. One hundred and eighty (180), day old female KN chicks were randomly distributed to three dietary treatment groups for a period of 30 weeks. Each treatment comprised three replicates, each containing 20 chicks. The basal diet ($T_1$) contained 15 IU VE/kg and the two experimental diets were supplemented with 150 and 300 IU VE/kg (diets $T_2$ and $T_3$, respectively). DL-α-tocopherol acetate was used as the source of VE. All chicks were provided feed and water *ad libitum*. Production performance in terms of body weight, egg weight and hatchability did not differ significantly ($p>0.05$), whereas sexual maturity, egg production and fertility differed significantly ($p<0.05$) in $T_2$ compared to the other two groups. Egg quality traits in terms of albumin weight, yolk weight, shell thickness, albumin index and yolk index did not differ significantly ($p>0.05$), whereas the Haugh unit score was significantly higher ($p<0.05$) in $T_2$ than the control ($T_1$) and high dose treatment group ($T_3$). From this study, it can be concluded that lower levels of dietary VE may be beneficial for production performance and Haugh unit score but have no effect on egg quality traits in Indian reared KN hens. (**Key Words :** Desi Fowl, Egg Production, Vitamin E, Sexual Maturity, Kadaknath)

## INTRODUCTION

Kadaknath (KN) is an important Indian reared poultry breed which is well known for poor egg production, slow growth rate, smaller body size as well as late sexual maturity. KN breed is being reared by tribal living in Dhar and Jabua districts of Madhya Pradesh, India. Despite a drastic increase in the import of high yielding strains from across the world, the local breed still retain preference in its native environment mainly due to its special capabilities i.e., good forages, less cost and efficient mothers. The birds require no extra care and housing which makes them suitable for landless labourers and marginal farmers. The KN breed reveals appreciable degree of resistance to diseases compared with other exotic breeds of fowl in its natural habitat in free range. These birds are also resistant to extreme climatic conditions like summer heat and cold winter stress and thrive very well under adverse environment like poor housing, poor management and poor feeding (Thakur et al., 2006). However there is very little information available regarding description, native breeding areas, geographical, demographical, morphological and productive traits of the KN breed of poultry. This breed, due to pressure from high yielding genetic stock is on the verge of extinction. The conservation and systemic study of this breed using modern technologies is essential for assessment of its productive and reproductive potential along with other traits as a pure breed.

Vitamin E (VE) plays an important role in avian reproduction. In broiler diets, supplementing with VE at levels higher than NRC (1994) requirement had better live weight gain and feed conversion ratio (Colango et al., 1984). Dietary supplementation of VE gives positive effects on production and reproduction traits because this antioxidant is not synthesized in the body (Chan and Decker, 1994). VE has a positive effect on growth performance of poultry by increasing resistance to disease and stress (Surai, 1991). In recent years, VE supplementations have been widely used in poultry diets and the levels for enhancing productive and reproductive performances (Surai, 1999; Biswas et al., 2007). Inadequate doses of VE in the basal diet resulted with slow growth rate, enlargement of kidney and liver leucocytosis and anaemia (Ayed et al., 1989).

The objective of this study was to determine the

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possible beneficial effects of dietary VE supplementation on production performance and egg qualities in KN hens. Most of the research work conducted on VE in poultry was related to exotic, high yielding breeds (Surai, 1999) and quail (Biswas, 2007) species. No information is available in literature on the effect of VE on production performances and egg quality traits in Indian reared KN hens. To strengthen the available knowledge, this work was carried out in Indian reared KN hen.

## MATERIALS AND METHODS

### Experimental stock

One hundred and eighty day old female KN chicks were randomly divided in to nine groups each of 20 chicks (3 treatments×3 replicates). The average chick's weight was 37.35 gm/chicks. Same number of male KN chicks also taken for fertility measurement. The experiment had a randomized block design (Snedecor and Cochran, 1994). Chicks were reared under uniform husbandry conditions (14 h light/d, relative humidity 60% and 25-32°C). Feed and water were given *ad libitum*. The same technician provided feed, water and collected data from the birds during the course of the experiment. The experiment followed the guidelines of "Institutional Animal Ethics Committee (IAEC, CARI, Izatnagar)".

### Formulation of experimental diets

The basal diet ($T_1$) contained 21% crude protein (CP), 2,900 Kcal/kg ME, 3% total calcium and 0.5% total phosphorus (Table 1). $T_2$ and $T_3$ were formulated to contain an additional 150 and 300 IU VE/kg diet, respectively. DL-α tocopherol acetate was used as the source of VE.

**Table 1.** Composition of the basal diet

| Ingredients | |
|---|---|
| Composition (g/kg) | |
| Maize | 590 |
| Soybean | 200 |
| DORB | 75 |
| Fish meal | 60 |
| Limestone | 25 |
| Oyster shell | 15 |
| Marble chips | 20 |
| Dicalcium phosphate | 10 |
| Sodium chloride | 5 |
| Amount (g/kg) | |
| DL-methionine | 0.150 |
| Choline chloride | 0.300 |
| Mineral mixture (Premix-1) | 0.125 |
| Vitamin A, $B_2$, $D_3$, K (Premix-2) | 0.040 |
| Vitamin B complex (Premix-3) | 0.050 |
| Calculated composition | |
| Crude protein (g/kg) | 210 |
| Crude fibre (g/kg) | 23.5 |
| Total calcium (g/kg) | 30.0 |
| Total phosphorus (g/kg) | 5.0 |
| ME (Kcal/kg) | 2,900 |
| Vitamin E (IU/kg) | 15.0 |
| Selenium (mg/kg) | 0.20 |

Premix-1: Each g of mineral mixture contained: 200 mg of $FeSo_4{\cdot}7H_2O$, 20 mg of $CuSo_4{\cdot}5H_2O$, 200 mg of $MnSo_4{\cdot}H_2O$, 150 mg of $ZnSo_4{\cdot}7H_2O$, 1 mg of KI.

Premix-2: Each g of vitamin A, $B_2$, $D_3$, K (Spectromix, Ranbaxy) provided: vitamin A (retinol) 540 mg, vitamin $B_2$ (riboflavin) 50 mg, vitamin $D_3$ (cholecalciferol) 400 mg, vitamin K (menadione) 10 mg.

Premix-3: Each g of B-Complex provided: vitamin $B_1$ (thiamine) 2 mg, folic acid 10 mg, pyridoxine HCl 4 mg, Cyanocobalamin 10 µg, nicotinamide 12 mg.

### Determination of production performance

The body weights of each hen were taken at the end of the experiment with the help of weighing balance with 1 g accuracy. Age at sexual maturity or the age at first lay was measured when the hen started laying eggs. Egg production from each treatment was recorded for a period of 6 wks ($25^{th}$ -$30^{th}$). Proper labeling on each egg was done in each and every day. Egg weight was taken by an analytical balance up to two decimals of a gram.

### Determination of fertility and hatchability

Healthy adult KN male of similar age to the females were randomly selected and housed with the ratio of 1:1 in each cage. After two weeks of adaptation, eggs (40 eggs×3 treatments×3 replicates = 360 eggs) were collected daily from $25^{th}$ week to $30^{th}$ week (6 week) and stored at 12°C, pooled by treatment group every week, then incubated under standard conditions for 22 days (37°C temp. and 65% humidity). After 9 days of incubation the eggs were candled to determine fertility of the developing embryo. If there was no evidence from candling on day 9 that the embryo was alive, then that embryo was classified as dead. Fertility was determined as the ratio of number of fertile eggs to the number of total eggs set. Egg hatchability is defined as the ability of the developed embryo to emerge from the egg over a 48-hour interval of time, i.e., days 21 or 22 after the initiation of the incubation process. For determining the percent hatchability, only the population of embryos that were judged to be alive on day 18 of candling, was included in the calculation.

### Determination of egg quality traits

135 eggs (15 eggs×3 treatments×3 replicates = 135 eggs) were collected for this experiment. The egg quality traits like shell thickness, albumin index, yolk index,

albumin weight and yolk weight were estimated according to Singh and Panda (1987). Haugh unit score was calculated by the method described by Kondaiah et al. (1983). After measuring the external characters, the eggs were broken open on the egg breaking stand and the contents were poured into a petri-dish for measuring their qualities. The height of the thick albumin and yolk were measured using Ames tripod stand micrometer Haugh (1937). The length and width of the thick white and yolk were measured using vernire caliper and the mean diameters were calculated. Thereafter, yolk was gently separated from the albumin, adherent albumin was removed by rolling the yolks over a filter paper and the yolk weight was recorded. The egg shell was washed to remove the adhering albumin and their thickness was measured with an Ames micrometer (Ames 25 M5). Yolk index was calculated as ratio of yolk height to yolk width while Haugh unit was determined based on albumin height and egg weight.

**Statistical analysis**

The data were analyzed using for ANOVA (Snedecor and Cochran, 1994) and Duncan's multiple range tests (Duncan, 1955) by comparing means for significant differences.

## RESULTS AND DISCUSSION

A summary of the values for production performances and egg quality traits are presented in Table 2 and Table 3.

Production performances in terms of body weight, egg weight and hatchability did not differ significantly ($p>0.05$) between the different dietary treatment groups, whereas, sexual maturity, egg production and fertility were significantly ($p<0.05$) higher in $T_2$ group compared to the other groups i.e. $T_1$ and $T_3$.

In the present study no significant differences were observed in body weight among the different treated groups. Bartov et al. (1991) and Biswas et al. (2005) also reported the same pattern of the body weight in case of Japanese quail. Low doses (150 IU VE/kg diet) of VE advanced the sexual puberty in KN hens by 10 days in comparison to control as well as high dose treated group and the results differed significantly ($p<0.05$). But our results are not in agreement with Bartov et al. (1991) who reported that supplemental of VE (125 mg/kg diet) did not have any effect on the age of sexual maturity in laying hens. There were no significant differences between control and dietary treated groups in case of egg weight. Similar results were reported for laying hens by Bartov et al. (1991) and Muduuli et al. (1982).

Egg production was statistically ($p<0.05$) higher in $T_2$ group compare to the other two groups. Our results are in agreement with the finding of Ciftci et al. (2005) who reported that supplemental VE (125 mg/kg diet) in laying hens improved egg production significantly; however Bartov et al. (1991) indicated no improvement of egg production in laying hens. Sunder et al. (1999) reported that 0 to 200,000 mg/kg VE supplementation did not significantly influence pullet performance. During eggshell formation excess amount of VE (100 mg or 200 mg) inhibited prostaglandin biosynthesis. Prostaglandins may regulate ovulation and are correlated with production performance (Mezes and Hides, 1992). However, Bollengier-lee et al. (1999) reported that diets supplemented with 125 mg/kg or more of VE significantly increased egg production of hens after heat stress. VE supplementation of diets containing high amounts of polyunsaturated fatty acids may prevent feed oxidation and may contribute to egg

**Table 2.** Effect of vitamin E on production performances traits in Indian reared KN hen (Mean±SEM, N = 45)

| Group | Vitamin E added (IU/kg diet) | Body weight (g) | First egg lay (days) | Egg production /6 wks/bird | Egg weight (g) | Fertility (%) | Hatchability (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 0 | 1,129.05±20.52 | 158.20±2.10b | 19.50±1.44a | 41.84±1.23 | 83.14±3.25a | 80.24±2.35 |
| $T_2$ | 150 | 1,177.32±26.22 | 148.60±3.58a | 25.40±0.85b | 42.97±0.95 | 91.27±2.16b | 86.15±3.89 |
| $T_3$ | 300 | 1,116.72±19.64 | 157.60±1.71b | 20.50±1.50a | 41.45±1.15 | 86.39±3.76a | 82.27±2.75 |
| | | NS | p<0.05 | p<0.05 | NS | p<0.05 | NS |

Mean values bearing the same superscripts in a column do not differ significantly ($p<0.05$). NS = Non significant.

**Table 3.** Effect of vitamin E on egg quality traits in Indian reared KN hen (Mean±SEM, N = 45)

| Group | Vitamin E added (IU/kg diet) | Albumin weight (g) | Yolk weight (g) | Albumin index (%) | Yolk index (%) | Shell thickness (mm) | Haugh unit score (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 0 | 21.21±0.21 | 15.20±0.15 | 8.43±0.19 | 35.11±0.74 | 0.31±0.03 | 68.51±2.34a |
| $T_2$ | 150 | 22.02±0.35 | 14.23±0.24 | 6.11±0.28 | 36.36±0.98 | 0.30±0.02 | 83.10±1.71b |
| $T_3$ | 300 | 21.59±0.49 | 14.19±0.12 | 7.45±0.39 | 34.48±0.89 | 0.31±0.08 | 73.86±1.85a |
| | | NS | NS | NS | NS | NS | p<0.05 |

Mean values bearing the same superscripts in a column do not differ significantly ($p<0.05$). NS = Non significant.

formation. These beneficial protective effects of vitamins were evidenced by increase of body weight gain and of egg production and qualities in supplemented laying hens in comparison to control birds (Cheng et al., 1990; Gey, 1998).

In the present study, fertility was significantly ($p<0.05$) increase after providing 150 IU VE/kg diet. Lin et al. (2004) reported that fertility was decrease when basal diets were provided but increased when VE was added in chicken diet. VE deficiency adversely affects the fertility of Japanese quail (Biswas et al., 2007). No significant differences were observed with hatchability in the present study. This is consistent with reports that dietary VE did not improve the hatchability rate (Lin et al., 2004). However, Muduuli et al. (1982) observed that different levels of dietary supplemented VE improved the hatchability rate of chickens. Studies on KN, concerning the relationship between production performances and dietary VE supplementation have not been published so far and to our knowledge, the present report is the first one on this subject.

No significant differences ($p>0.05$) were observed in egg quality traits (except Haugh unit score) in term of albumin weight, yolk weight, shell thickness, albumin index and yolk index between the control and VE treated groups, whereas, Haugh unit score of low dose treated group ($T_2$) were significantly higher ($p<0.05$) from the rest of the groups. These results disagree with Radwan et al. (2008) who reported that the addition of VE (100 or 200 mg/kg diet) in laying hens diets insignificantly decreased albumen weight with increased yolk weight. According to Nwachukwu et al. (2006), high Haugh unit score is indicating that the eggs are good quality. So, it is concluded that $T_2$ group produced superior quality eggs compared to other two groups. On these aspects, Parmar et al. (2006) measured the different egg quality traits in KN hens but literature is silent about the relationship between egg quality trait and VE in KN hens. The present study is the first report on these relationships.

From the foregoing discussion, it is concluded that supplementing the diets with a moderate level of VE (150 IU/kg) improve the production performance and fertility but there is no significant effect on egg quality traits (except Haugh unit score) of Indian reared KN hens. However, further work is essential to extend these findings.

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