# Effects of Dietary Vitamin E on Male and Female Fertility Functions in Chicken

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**Abstract:** Vitamin E has an effect in the maintenance of sperm and egg qualities. a suitable amount of vitamin E in poultry diet significantly protects semen with sperm qualities in male birds and egg qualities in female birds that by decreasing the lipid peroxidation in semen and eggs.
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## Introduction

Vitamin E is absorbed through the lymphatic pathway and transported into the systemic circulation. [1] Due to fat-soluble properties it is incorporated in plasma membranes and lipid storage organelles, so it is widely distributed throughout the body [2]. Vitamin E interacts with other dietary components, as selenium, polyunsaturated fatty acids, sulphur-containing amino acids, vitamins, minerals, and synthetic antioxidants [3]. Vitamin E is interfere in iron metabolism and steroidogenesis [4].

Vitamin E helps in transport amino acids and may be lipids in the intestine [5] and it playes a role in stimulation of humoral and cellular immune responses against infectious diseases [6]. Some disorders related to Vitamin E deficiency caused in liver, kidney, lung, and in adipose tissue [7]. Vitamin E deficiency may help in increasing the risk of ischemic heart disease, breast cancer, and the incidence of infections [8], vitamin E is primarily crucial for fertility in poultry. Reproductive functions are crucial for healthy offspring and species survival of all animals, including poultry. Dietary supplementation with vitamin E increases the resistance of poultry against infectious diseases [9].

The aim of this paper is to review studies the effects of dietary vitamin E on male and female fertility in poultry species.

## Effect of vitamin E on chicken immunity

The standard supplementation with certain minerals and vitamins helps to increase the birds' immune resistance against pathogenic diseases [10]. The dietary requirement for vitamin E in poultry feed is highly variable and depends on the concentration and type of fat in the diet, the concentration of selenium, and the presence of pro-oxidants and antioxidants [11] The National Research Council's Committee on Animal Nutrition, USA, provided the nutrient requirements for poultry species According to its recommendations, poultry feed can be supplemented with 10 IU of vitamin E per kg feed. for chickens aged up to six weeks, 5 IU/kg feed for chickens aged over six weeks, 12 IU/kg [11] vitamin E deficiency impairs feather development in chickens [12]. Some disorders occur in chicken due to vitamin E deficiency as nutritional muscular dystrophy that affects striated muscles, erythrocyte hemolysis that affects erythrocytes, and exudative diathesis, affects capillary walls and can affecting hepatic mitochondria and microsomes, and causing accumulation of ceroid in adipose tissues, and lead to cerebellar encephalomalacia in chickens [12].

## Effects of Dietary Vitamin E on Male Fertility Functions in chickens

Male fertility is principally related to semen and sperm qualities, including the volume of semen, concentration of sperms in the semen, sperm viability, sperm motility, sperm forward progression, and the sperm fertilizing capacity. These qualities can be affected by several environmental factors and endocrine disrupting chemicals, which may enter the body through diet, respiration, and skin contact [13].

Male chickens were fed a diet high in linoleic acid (7.3%) and low in vitamin E (4.3 mg/kg diet) from hatch to 28 weeks of age, and high in both linoleic acid (7.3%) and vitamin E (166.3 mg/kg diet) from 28 to 40 weeks. As a result, the adverse effects on fertility and semen concentration were restored in chickens fed on the diet high in vitamin E. Thus, the adverse effects of linoleic acid on male fertility are not permanent but can be reversed by vitamin E supplementation [14].

Male chicks were fed basal diet supplemented with 10, 100, or 200 mg/kg *vitamin E* from hatch to 30 weeks of age. An analysis performed during the final three weeks of the trial revealed that the proportion of abnormal and dead spermatozoa was significantly lower and the fertilizing capacity was

significantly higher in birds fed with 100 mg/kg of vitamin E. Moreover, the vitamin E status of semen and spermatozoa was higher in birds fed with 100 mg/kg of vitamin E than that in birds fed with 10 mg/kg of vitamin E [15].

It is well known that vitamin E interacts with selenium, and that both play a role in the maintenance of reproductive functions as well as in the reduction of reactive oxygen species and free radical generation [16]. Male chickens were fed a balanced diet supplemented with selenium (0.3 mg/kg diet) and vitamin E (20 or 200 mg/kg diet) and observed that the activity of glutathione peroxidase in testes, semen, and sperms was significantly increased [17].

The study by Jerysz and Lukaszewicz suggests that combined supplementation with selenium and vitamin E enhances the reproductive functions of certain avian species that naturally show low reproductive behavior [18]. Antioxidant supplementation is not only important for lipid-containing poultry feed but also a prerequisite for any basal diet in order to maintain fertility. In a study by Lin and colleagues [19], freshly hatched Taiwan Native male chicks were fed with maize/soybean diets for up to 23 weeks of age. After 23 weeks, the birds were allowed to feed on maize/soybean diets supplemented with 80 mg/kg feed of *dl*-α-tocopheryl acetate for up to 52 weeks of age. Males fed with the vitamin E supplemented diet showed significantly higher sperm viability, sperm motility, and sperm concentration in the semen. This study suggests that a maize/soybean containing diet is inadequate for maintaining the fertility functions in male birds, thus vitamin E supplementation is required.

The semen volume, sperm motility, and sperm capacity in fertilizing eggs had significantly increased in birds fed with the vitamin E supplemented diet. Several investigators have demonstrated the association of vitamin E deficiency with improved male reproductive functions. It has been identified as an anti-sterility vitamin, and its deficiency or long-term in the diet causes abnormal spermatogenesis and affects the semen qualities ( sperm viability, sperm motility, and sperm capacity) [20].

**Effects of Dietary Vitamin E on Female Fertility Functions in chickens**

In chickens the daily egg production, the egg quality, including egg weight and components of the yolk and albumin, and the egg fertility and hatchability are the most important factors that determine healthy offspring. The number of fertile eggs produced for hatching indictates the success fertility of hens [21]. The yolk and albumin stored in the eggs considered the nutrients required for embryo development. A chicken egg contains significant amounts of nutrients, including carbohydrates, proteins, lipids, vitamins, and trace elements, and these nutrients can be increased or decreased in eggs by changing the dietary composition. chickens fed with a standard diet, have relatively stable of the concentrations of total lipids, including the polyunsaturated fatty acids of the linoleic acid series, and of antioxidants [22]. In hens fed with a basal diet high in linoleic acid (7%) and low in vitamin E (20 IU/pound feed) for eight weeks, egg production had decreased from 78% to 25%. Only 37% of the eggs were fertile, and none of the fertile eggs was hatched. When hens were fed with a diet containing high amounts of both linoleic acid (7%) and vitamin E (100 IU/pound feed) for eight weeks, the egg production reached an average of 57%. Seventy-six percent of the eggs were fertile and 67% of the fertile eggs were hatched. So vitamin E acts as an antioxidant, and protects female fertility by preventing the breakdown of linoleic acid, which would lead to oxidative damage. [23], on the other hand hens which were fed diets low in linoleic acid do not require additional vitamin E or antioxidants for maintenance of egg production, fertility, and hatch of fertile eggs [24]. the antioxidant property of vitamin E is very helpful in reducing the adverse effects of toxic compounds like vicine., an adequate amount of vitamin E was found necessary in the poultry diet for maintaining female fertility, regardless of whether or not the diet is high in polyunsaturated fatty acids [25] the amount of vitamin E in the diet should be correlated with the amount of dietary selenium and polyunsaturated fatty acids. If the poultry diet contains a sufficient amount of selenium and is not rich in polyunsaturated fatty acids, about 20 mg vitamin E per kg diet is required for maintaining fertilization rate of breeding hens [26]. an amount of more than 500 µg vitamin E per egg to ensure the hatching of healthy chicks [27].

**References**

1. Bjorneboe A., Bjorneboe G.E., Drevon C.A. Absorption, transport and distribution of vitamin E. J. Nutr. 1990;120:233–242.
2. Wang X., Quinn P.J. Vitamin E and its function in membranes. Prog. Lipid Res. 1999;38:309–336.
3. Chen L.H. Interaction of vitamin E and ascorbic acid (review) In Vivo. 1989;3:199–209.
4. Nair P.P. Vitamin E and metabolic regulation. Ann. N. Y. Acad. Sci. 1972;203:53–61.
5. Green J. Vitamin E and the biological antioxidant theory. Ann. N. Y. Acad. Sci. 1972;203:29–44.

6. Tengerdy R.P. Vitamin E, immune response, and disease resistance. Ann. N. Y. Acad. Sci. 1989;570:335–344.
7. Herting D.C. Perspective on vitamin E. Am. J. Clin. Nutr. 1966;19:210–218.
8. Machlin L.J. Clinical uses of vitamin E. Acta Vitaminol. Enzymol. 1985;7:33–43.
9. Tengerdy R.P. Vitamin E, immune response, and disease resistance. Ann. N. Y. Acad. Sci. 1989;570:335–344.
10. Latshaw J.D. Nutrition—Mechanisms of immunosuppression. Vet. Immunol. Immunopathol. 1991;30:111–120.
11. National Research Council. Nutrient Requirements of Poultry. 9th revised ed. The National Academies Press; Washington, DC, USA: 1994. pp. 1–157.
12. Combs G.F. Assessment of vitamin E status in animals and man. Proc. Nutr. Soc. 1981;40:187–194.
13. Rengaraj D., Kwon W.S., Pang M.G. Effects of motor vehicle exhaust on male reproductive function and associated proteins. J. Proteome Res. 2015;14:22–37.
14. Arscott G.H., Parker J.E. Effectiveness of vitamin E in reversing sterility of male chickens fed a diet high in linoleic acid. J. Nutr. 1967;91:219–222.
15. Biswas A., Mohan J., Sastry K.V. Effect of higher dietary vitamin E concentrations on physical and biochemical characteristics of semen in Kadaknath cockerels. Br. Poult. Sci. 2009;50:733–738.
16. Tappel A.L. Selenium-glutathione peroxidase and vitamin E. Am. J. Clin. Nutr. 1974;27:960–965.
17. Surai P., Kostjuk I., Wishart G., Macpherson A., Speake B., Noble R., Ionov I., Kutz E. Effect of vitamin E and selenium supplementation of cockerel diets on glutathione peroxidase activity and lipid peroxidation susceptibility in sperm, testes, and liver. Biol. Trace Elem. Res. 1998;64:119–132.
18. Jerysz A., Lukaszewicz E. Effect of dietary selenium and vitamin E on ganders' response to semen collection and ejaculate characteristics. Biol. Trace Elem. Res. 2013;153:196–204.
19. Lin Y.F., Chang S.J., Yang J.R., Lee Y.P., Hsu A.L. Effects of supplemental vitamin E during the mature period on the reproduction performance of Taiwan native chicken cockerels. Br. Poult. Sci. 2005;46:366–373.
20. Bjorneboe A., Bjorneboe G.E., Drevon C.A. Absorption, transport and distribution of vitamin E. J. Nutr. 1990;120:233–242.
21. Khan R.U. Antioxidants and poultry semen quality. Worlds Poult. Sci. J. 2011;67:297–308.
22. Lin Y.F., Chang S.J., Hsu A.L. Effects of supplemental vitamin E during the laying period on the reproductive performance of Taiwan native chickens. Br. Poult. Sci. 2004;45:807–814.
23. Arscott G.H., Parker J.E., Dickinson E.M. Effect of dietary linoleic acid, vitamin E and ethoxyguin on fertility of male chickens. J. Nutr. 1965;87:63–68.
24. Machlin L.J., Gordon R.S., Marr J.E., Pope C.W. Effect of antioxidants and unsaturated fatty acids on reproduction in the hen. J. Nutr. 1962;76:284–290.
25. Muduuli D.S., Marquardt R.R., Guenter W. Effect of dietary vicine and vitamin E supplementation on the productive performance of growing and laying chickens. Br. J. Nutr. 1982;47:53–60.
26. Hennig A., Marckwardt E., Richter G. Relations between vitamin-E supply and the fertility of hens. Arch. Tierernahr. 1986;36:519–529.
27. Yoshida M., Hoshii H. Effect of dilauryl succinate on reproduction of the cock and hen and preventive effect of vitamin E. J. Nutr. 1976;106:1184–1191.


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