# The effects of humic acid on egg production and egg traits of laying hen

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**ABSTRACT**: The effects of humic acid on feed consumption, egg production, feed efficiency, egg weight and external and internal egg quality of laying hens were studied during feeding periods. A total of 180 (Hysex Brown) layers (36 weeks of age) were used in this experiment. There was one control and two experimental groups, each containing 60 hens and 4 subgroups. The experimental period lasted 16 weeks. At the end of the experiment, the supplementation of humic acid had a significant effect on feed consumption and feed efficiency. An increase in egg production was determined when humic acid was added to the diets at 30 g/t of feeds (91.70%) and 60 g/t of feeds (91.32%). There were no significant differences between the groups in egg shell thickness, egg shell breaking strength, yolk index, albumen index and Haugh unit. It can be therefore concluded that the dietary supplementation of humic acid at doses of 30 and 60 g/t feed can be used to improve egg production, egg weight and feed efficiency.

**Keywords**: egg quality; egg production; egg weight; humic acid

The term 'humus' has been known to science for years. Humus is a transformation product of animal and plant organisms. Humic substances are chemical compounds which derive from stabilised organic matter in the soil or humus and are formed during decay of plant and animal material in soil (Stevenson, 1980). The humic acids to come into existence such as phenols, carbohydrates and amino acids transform into much more complex compounds.

Humic acid is a substance of very complex structure which is practically insoluble in water and shows a very poor biological activity. Its molecular mass is from 20 000 to 150 000. Humic acids use hydrocarbon bonds to create molecule-forming chains. The humate reacts with potassium, magnesium, aluminium and iron that are always present in soil and forms organomineral bridges that bind mechanical particles of the soil into a life-sustaining structure for microorganisms. The humate molecules, which entered the soil structure as described earlier, contain a lot of functional groups capable of ion-exchange reactions. Humic acids reduce the toxic effect of residual amounts of herbicides, heavy metals, soil-polluting radionuclides and other harmful substances. On the other hand, the use of humates in the zone of risky agriculture is particularly important. Humates have the ability to decrease the level of nitrates and nitrogen in produce. Humic acid is the reliable protection for plants and feeds against harmful compounds (Freter et al., 1983).

The use of humic acids in animal feeds brings a number of advantages for animal health and growth.

(1) Humic acid is able to form a protective film on the mucous epithelium of the membrane and gas tract against infections and toxins. The macrocolloidal structure of adstringent effects of humic acids shields the mucous membrane of the stomach and guts.

(2) Humic acid has the ability to influence in particular the metabolism of protein carbohydrates of microbes by catalytic means. This leads to a di-

rect devastating of bacterial cells or virus particles (Huck et al., 1991).

(3) Dermal, oral or subcutaneous application of humic acid leads to inhibitory effects on inflammation.

(4) The detoxifying benefits of humic acid in the soil cover the full spectrum of accumulated toxins associated with chemical farming. When humic acid is added to the diet, heavy metals, nitrates, fluoride, organophosphates, carbaryl and chloride organic insecticides can be adsorbed and excreted.

(5) Humic acid stimulates the immune system receptors in the gut lining to protect against pathogens.

In recent years, it has been observed that humates included in the feed of poultry promote growth (Bailkey et al., 1996; Parks et al., 1996; Eren et al., 2000; Kocabagli et al., 2002; Karaoglu et al., 2004).

This research was carried out to determine the effects of humic acid on egg production, feed consumption and conversion, mass of eggs and scraps and quality of eggs.

Table 1. Percentage diet composition

| Feedstuffs | % |
|---|---|
| Maize | 39.00 |
| Wheat | 25.00 |
| Soybean meal (44 % crude protein) | 22.00 |
| Vegetable fat | 1.70 |
| Meat and bone meal | 3.00 |
| Limestone | 8.00 |
| DCP | 0.50 |
| Salt | 0.25 |
| DL-methionine | 0.20 |
| Vitamin premix* | 0.25 |
| Mineral premix** | 0.10 |

*Rovimix 123-T; each 2.5 kg Rovimix 123-T contained: vitamin A 12 000 000 IU, vitamin $D_3$ 2 000 000 IU, vitamin E 35 000 IU, vitamin $K_3$ 5 000 mg, vitamin B1 3 000 mg, vitamin B2 6 000 mg, niacin 20 000 mg, calcium D-pantothenate 6 000 mg, vitamin $B_6$ 5 000 mg, vitamin $B_{12}$ 15 mg, folic acid 750 mg, D-biotin 45 mg, choline chloride 125 000 mg and vitamin C 50 000 mg

**Remineral S; each kg Remineral S contained: Mn 80 000 mg, Fe 60 000 mg, Zn 60 000 mg, Cu 5 000 mg, Co 200 mg, I 1 000 mg, Se 150 mg and Ca 446 925 mg

## MATERIAL AND METHODS

In this research, a total of 180 commercial layer hybrid Hysex Brown hens at 36 weeks of age were used. The research was carried out on a total of 3 groups, consisting of 1 control and 2 treatment groups. Each treatment group was replicated four times as subgroups, comprising 15 birds each. The study was carried out at the Animal Nutrition and Nutrition Related Disease Department of the Faculty of Veterinary Medicine, Ankara University. The hens were placed in two floored batteries, each cage containing three hens. Throughout the research, a lighting programme of 17 hours a day was applied besides daylight. The rations containing 17% crude protein and 2 800 kcal/kg metabolizable energy (ME) were used. Research rations were based on wheat, maize and soybean meal. Humic acid (G-Leon-85 Granül) was not added to the rations given to the control group. In the first treatment group 30 g humic acid and in the second treatment group 60 g humic acid were added to 1 ton of feed. The formulations of the research rations are shown in Table 1. Each kg of humic acid contained 85% polymeric polyhydroxy acid.

The research rations were prepared at a commercial feed factory. The feed was then brought to the Animal Nutrition and Nutrition Related Disease Department of the Faculty of Veterinary Medicine, Ankara University and used in this research.

The amounts that the animals would consume daily were provided in feeders. The animals were fed the research rations for 16 weeks. The amount of feedstuff and the amount of nutrients in the research rations were determined according to the methods described in the A.O.A.C. (1994), while the level of metabolizable energy (ME) in the rations was determined according to the method described in TSE (1994), (Table 2). The animals were fed in groups and via weekly measurements, the mean of group feed consumption was determined. Egg production records were taken daily in each group. Eggs were weighed at weekly intervals after being stored at room temperature for 24 hours and their masses were measured. The egg shell breaking strength values were measured by the breaking strength measurement apparatus developed by Rauch (1965) and were given in kg/cm$^2$.

Shell pieces were taken from the pointed and blunt ends and the centre of the eggs and following the removal of the membranes, their thickness was measured with micrometer (Card and Nesheim, 1972).

Calculations concerning data of the groups and evaluation of the significance of differences between the mean values of the groups were done by the analysis of variance (Snedecor and Cochran, 1980) whereas the control of the significance of differences between the mean values of the group was performed by Duncan's test (Dawson and Trapp, 2001).

## RESULTS AND DISCUSSION

The average daily feed consumption of a hen was calculated as 132.74, 131.95 and 130.61 g for the control and treatment groups, respectively (Table 3). Mean feed consumption of groups was statistically significant ($P < 0.05$).

The values of feed conversion by animals in order to produce kg eggs/kg feed were calculated as 2.33, 2.23 and 2.18 for the control, 1st and 2nd treatment groups, respectively (Table 3). It was determined that the addition of humic acid individually to layer hen rations had a significant effect on feed conversion ($P < 0.05$). However, the addition of 60 g/t humic acid to layer hen rations resulted in an improvement of feed conversion by 6.44% compared to the control group.

Mean egg production values were calculated as 89.17%, 91.70% and 91.32% for control and treatment groups, respectively and the differences observed between the groups were not statistically significant (Table 3). The highest egg production was maintained in the 1st treatment group supplemented with dietary humic acid. In other words, the egg production of the 1st group was 2.84% higher than the egg production of the control group, 0.41% higher than that of the 2nd treatment group.

Eren et al. (2000) compared the effects of dietary humate (Farmagülatör DRY™) supplementation at 1.5 and 2.5 g/kg on broiler performance from 0 to 42 d. Although there was no performance difference at 21 d, they found that dietary supplementation of humate at 2.5 g/kg significantly improved the live weights of broilers at 42 d. The most beneficial effect was realised with feeding humate, a growth-promoting agent, during the 22 to 42 d feeding period.

Kocabagli et al. (2002) compared the effects of dietary humate (Farmagülatör DRY™) supplementation at 2.5 g/kg on broiler performance from 0 to 42 d. Body weights at 21 d were not affected by the dietary regimens. At 42 d, body weights and feed conversions of broilers were significantly affected by the dietary humate treatments. At the end of experimental period, feeding humate during the grower period had the most beneficial effect on broiler performance in terms of growth and feed conversion.

Humic acid stabilises the intestinal microflora and thus ensures an improved utilisation of nutrients in animal feed. This leads to an increase in the live weight of laying hens (Shermer et al., 1998).

Table 2. The values of metabolizable energy and nutrient content in experimental diets

| | Control group | Experimental group 1 (humic acids 30 g/t feed) | Experimental group 2 (humic acids 60 g/t feed) |
|---|---|---|---|
| Metabolizable energy (kcal/kg) | 2 802 | 2 805 | 2 808 |
| Dry matter (%) | 91.05 | 91.30 | 91.80 |
| Crude protein (%) | 17.05 | 17.08 | 17.11 |
| Crude cellulose (%) | 3.66 | 3.78 | 3.55 |
| Crude ash (%) | 11.11 | 11.28 | 11.21 |
| Ether extract %) | 2.35 | 2.44 | 2.38 |
| Calcium (%) | 3.41 | 3.44 | 3.73 |
| Phosphorus (%) | 0.58 | 0.62 | 0.61 |
| Methionine* (%) | 0.43 | 0.43 | 0.43 |
| Lysine* (%) | 1.32 | 1.32 | 1.32 |

*determined by calculation

Table 3. Feed consumption, egg production, egg weight and feed efficiency of control and experimental groups

| | Control group $\bar{x} \pm S_{\bar{x}}$ | Group 1 humic acid (30 g/t feed) $\bar{x} \pm S_{\bar{x}}$ | Group 2 humic acid (60 g/t feed) $\bar{x} \pm S_{\bar{x}}$ | $P$ |
|---|---|---|---|---|
| Feed consumption (g/day/hen) | $132.74 \pm 2.23^{b}$ | $131.95 \pm 2.67^{ab}$ | $130.61 \pm 3.22^{a}$ | 0.040* |
| Egg production (%) | 89.17 ± 4.05 | 91.70 ± 1.09 | 91.32 ± 0.59 | 0.450 |
| Feed efficiency kg feed/kg egg | 2.33 ± 0.04 | 2.23 ± 0.06 | 2.18 ± 0.07 | 0.235 |
| Egg weight (g) | 62.85 ± 0.60 | 64.30 ± 0.50 | 64.82 ± 0.55 | 0.080 |

$^{a,b}$ means within measurements followed by the same superscript are not statistically different from one another * $P < 0.05$

Table 4. Means of measurements of egg external and internal quality

| | Control group $\bar{x} \pm S_{\bar{x}}$ | Group 1 humic acid (30 g/t feed) $\bar{x} \pm S_{\bar{x}}$ | Group 2 humic acid (60 g/t feed) $\bar{x} \pm S_{\bar{x}}$ | $P$ |
|---|---|---|---|---|
| Egg shell thickness (mm × $10^2$) | 41.79 ± 0.44 | 42.39 ± 0.50 | 42.55 ± 0.67 | 0.44 |
| Egg shell breaking strength (kg/$cm^2$) | 3.99 ± 0.29 | 3.83 ± 0.18 | 3.84 ± 0.21 | 0.38 |
| Egg yolk index | 9.95 ± 0.74 | 10.45 ± 0.28 | 10.50 ± 0.48 | 0.76 |
| Egg albumen index | 42.03 ± 0.81 | 42.79 ± 1.46 | 42.84 ± 1.25 | 0.62 |
| Egg Haugh unit | 80.55 ± 1.50 | 80.96 ± 1.32 | 80.82 ± 1.29 | 0.99 |

The results concerning the improvement effect of the addition of humic acid to layer hen rations on feed conversion rates are similar to the results obtained from studies carried out on this subject (Eren et al., 2000; Kocabagli et al., 2002; Tancho, 2003).

Egg mass values were measured as 62.85, 64.30 and 64.82 g for the control, 1st, and 2nd treatment groups, respectively (Table 3). No statistically significant difference in egg weight between the groups was observed throughout the research. In other words, although the addition of humic acid to layer hen rations resulted in an increase in egg mass, it was not considered to be statistically significant.

It was observed that egg shell thickness, breaking strength, yolk index, albumen index and Haugh unit, which is a characteristic that defines egg quality, were not closely related to the addition of humic acid to layer hen rations (Table 4).

According to these results, it was concluded that the addition of humic acid to layer hen rations improved feed conversion rates, egg production and egg weight.

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