

## Effect of sulphur on blood picture of Fayoumi chickens

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### ABSTRACT

Fifty Fayoumi chickens were kept under standard management conditions for 55 days. They were fed a chick starter ration throughout the experiment. At 56 days of age the chickens were divided randomly into five groups and supplemented with sulphur powder at the rate of 0 (control), 1, 2, 3 and 4% in feed. Hemogram values, including erythrocyte count, haemoglobin concentration and packed cell volume, were significantly less in chickens supplemented 2, 3 and 4% sulphur than control chickens ( $P < 0.001$ ). Leukogram values showed leukocytosis ( $P < 0.001$ ), relative heterophilia ( $P < 0.001$ ), relative lymphocytosis ( $P < 0.01$ ) and no change in relative monocyte or eosinophil count in sulphur treated chickens compared with the controls. The study indicates that sulphur at higher doses, i.e., 2, 3 and 4% in feed, had adverse effects on haemogram and leukogram values, which may have grave consequences on the health and performance of chickens.

**Key words:** sulphur, chicken, blood

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### Introduction

Sulphur is one of the most abundant elements in the earth. Body needs of sulphur are primarily a matter of amino acid nutrition. It is a part of some amino acids, such as cystine and methionine, and two vitamins, including thiamine and biotin (MAYNARD and LOOSLI, 1969; PATRICK and SCHAIBLE, 1980). Excess feeding of sulphur causes destruction of vitamin D, increased

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production of faeces, loss of membrane permeability and fluid collection around the breast (PATRICK and SCHAIBLE, 1980). Hilly areas in Pakistan are attractive for poultry farming due to a favourable climate in summer. Some of these areas, such as Kalar Kahar, may contain up to 600 mg sulphur/litre water which is given to poultry as drinking water. It is likely that the continuous use of water containing sulphur could have adverse effects on the health of chickens.

The effect of sulphur on body mass and organ mass (ALAM et al., 1998) and serum proteins (ALAM and ANJUM, 1998) has been reported earlier. This study describes the effects of elementary sulphur on blood picture of Fayoumi chickens.

### **Materials and methods**

Fifty Fayoumi chickens were kept under standard management conditions for 55 days and fed on a chick starter ration (CP 18%, ME 2750 Kcal/kg) and water *ad libitum*. At 56 days of age the chickens were randomly divided into five equal groups, 10 chickens in each group. Group 1 (control) was given feed without sulphur. Groups 2 to 5 were supplemented with sulphur powder in feed at a dose rate of 1%, 2%, 3% and 4%, respectively, from 56 to 140 days of age.

Blood samples were collected from each group through the wing vein at 28 days, 56 days and 84 days post-treatment. Sodium salt of EDTA was used as anticoagulant at the rate of 1mg/ml of blood (BENJAMIN, 1978). Erythrocyte and total leukocyte counts were determined with the aid of an improved Neubauer counting chamber using Natt and Herrick diluent in a ratio of 1:100 (NATT and HERRICK, 1952). Haemoglobin concentration was determined by the spectrophotometric method using Drabkin's solution (BENJAMIN, 1978). Packed cell volume was determined by the Microhaematocrit method as described by BENJAMIN (1978). Blood smears were stained following the method of SHEN and PATTERSON (1983). Differential leukocyte count was performed as described by BENJAMIN (1978).

Data were subjected to analysis of variance and group means were compared by Duncam's Multiple Range Test at a probability level of 0.05

or less using Minitab, a Personal Computer statistical Package, Release 4.0 by Minitab Inc.

### Results

*Haemogram values.* There was no difference in erythrocyte count between chickens receiving 1% sulphur in feed and the control. Chickens receiving 2%, 3% and 4% sulphur had an erythrocyte count significantly less than the control (Table 1,  $P < 0.001$ ).

Haemoglobin (Hb) concentration was relatively less in chickens receiving 1% and 2% sulphur in feed. However, the difference compared

Table 1. Effect of sulphur on total erythrocyte count (millions/ml, mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	2.49 $\pm$ 0.23	2.44 $\pm$ 0.26	2.36 $\pm$ 0.28	2.08 $\pm$ 0.29	2.04 $\pm$ 0.29
56	1.91 $\pm$ 0.10	1.67 $\pm$ 0.09	1.45 $\pm$ 0.13	1.34*** $\pm$ 0.04	1.31 $\pm$ 0.07
84	1.87 $\pm$ 0.12	1.79 $\pm$ 0.09	1.27*** $\pm$ 0.06	1.33*** $\pm$ 0.03	1.32*** $\pm$ 0.05

\*\*\* $P < 0.001$  compared with the control

Table 2. Effect of sulphur on haemoglobin concentration (g/dl, mean  $\pm$  SE) in Fayoumi chickens (n = 10).

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	10.11 $\pm$ 0.25	9.94 $\pm$ 0.41	9.70 $\pm$ 0.31	9.60 $\pm$ 0.37	9.39 $\pm$ 0.55
56	10.86 $\pm$ 0.18	9.99 $\pm$ 0.33	10.02 $\pm$ 0.40	9.33*** $\pm$ 0.37	9.83 $\pm$ 0.31
84	10.69 $\pm$ 0.12	10.23 $\pm$ 0.27	9.86 $\pm$ 0.28	9.06*** $\pm$ 0.27	8.65*** $\pm$ 0.42

\*\*\* $P < 0.001$  compared with the control

Table 3. Effect of sulphur on packed cell volume (%; mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	33.30 $\pm$ 1.02	35.20 $\pm$ 1.49	33.90 $\pm$ 0.93	31.60 $\pm$ 0.60	32.23 $\pm$ 1.32
56	34.00 $\pm$ 0.36	31.51 $\pm$ 0.41	7.48*** $\pm$ 1.04	8.90*** $\pm$ 0.89	28.78*** $\pm$ 0.71
84	23.80 $\pm$ 1.20	33.88 $\pm$ 1.44	32.00 $\pm$ 1.21	8.85*** $\pm$ 0.77	24.79*** $\pm$ 0.05

\*\*\*P<0.001 compared with the control

Table 4. Effect of sulphur on total leukocyte count ( $\times 10^3/\mu\text{l}$ , mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	20.76 $\pm$ 1.42	21.90 $\pm$ 1.28	23.36 $\pm$ 0.72	23.72 $\pm$ 1.38	24.33 $\pm$ 1.05
56	16.73 $\pm$ 1.24	18.10 $\pm$ 2.24	19.10 $\pm$ 2.25	22.53** $\pm$ 1.65	22.13** $\pm$ 1.65
84	12.72 $\pm$ 0.90	13.60 $\pm$ 1.14	14.56 $\pm$ 0.71	15.23 $\pm$ 1.32	17.03 $\pm$ 1.65

\*\*P<0.01 compared with the control

Table 5. Effect of sulphur on absolute heterophil count ( $\times 10^3/\mu\text{l}$ , mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	6664 $\pm$ 355	6877 $\pm$ 447	6821 $\pm$ 367	7069 $\pm$ 285	7275 $\pm$ 258
56	5705 $\pm$ 283	6082 $\pm$ 320	5596*** $\pm$ 109	6714 $\pm$ 169	5842*** $\pm$ 259
84	3905 $\pm$ 123	4148 $\pm$ 163.2	4121 $\pm$ 106	4264 $\pm$ 139	5092 $\pm$ 187

\*\*\*P<0.001 compared with the control

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Table 6. Effect of sulphur on absolute lymphocyte count (mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	12456 $\pm$ 386	13074 $\pm$ 440	14250 $\pm$ 259	14612 $\pm$ 268	15450 $\pm$ 185
56	9754 $\pm$ 274	10914 $\pm$ 277	12071** $\pm$ 210	14081 $\pm$ 228	14274** $\pm$ 427
84	7747 $\pm$ 187	8326 $\pm$ 237	9100 $\pm$ 111	9686 $\pm$ 151	10751 $\pm$ 199

\*\*P<0.01 compared with the control

Table 7. Effect of sulphur on absolute monocyte count (mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	976 $\pm$ 102	1336 $\pm$ 118	1472 $\pm$ 124	1233 $\pm$ 135	1046 $\pm$ 124
56	786 $\pm$ 92	742 $\pm$ 91	898 $\pm$ 97	1172 $\pm$ 176	1284 $\pm$ 135
84	661 $\pm$ 81	707 $\pm$ 97	874 $\pm$ 36	762 $\pm$ 84	766 $\pm$ 104

Table 8. Effect of sulphur on absolute eosinophil count (mean  $\pm$  SE) in Fayoumi chickens (n = 10)

Days post-treatment	Sulphur concentration in feed				
	Control	1%	2%	3%	4%
28	664 $\pm$ 79	613 $\pm$ 96	864 $\pm$ 114	830 $\pm$ 52	681 $\pm$ 71
56	485 $\pm$ 39	453 $\pm$ 54	535 $\pm$ 78	586 $\pm$ 138	730 $\pm$ 47
84	407 $\pm$ 73	422 $\pm$ 55	466 $\pm$ 29	518 $\pm$ 46	426 $\pm$ 51

with control chickens was statistically non-significant. Chickens receiving 3% and 4% sulphur in feed had a significantly lesser Hb concentration than the controls (Table 2,  $P < 0.001$ ).

Packed cell volume (PCV) did not differ between chickens receiving 1% sulphur in feed and the controls. PCV was significantly less in chicken receiving 2%, 3% and 4% sulphur than the controls (Table 3,  $P < 0.001$ ).

*Leukogram.* Total leukocyte count (TLC) was relatively higher, but statistically non-significant, in chickens receiving 1% and 2% sulphur in feed than the controls. TLC was significantly higher in chickens receiving 3% and 4% sulphur than the controls (Table 4,  $P < 0.001$ ).

Relative heterophil count was significantly less in chickens receiving 2%, 3% and 4% sulphur compared with the controls (Table 5,  $P < 0.001$ ).

There was a dose-related increasing trend, or relative lymphocyte count, in chickens receiving 1%, 2%, 3% and 4% sulphur compared with the controls (Table 6,  $P < 0.01$ ).

Relative monocyte and eosinophil counts did not differ significantly between chickens receiving sulphur in feed and the controls (Tables 7 and 8).

## Discussion

Nutritional aspects of sulphur requirement in poultry have been studied by various workers (SUMMERS et al., 1990; KIRILIV et al., 1991; SUGAHARA and KUBO, 1992). Little information is available on the toxic aspects of sulphur in the chicken (KATZ and BAKER, 1975; KO et al., 1985; HIKAMI et al., 1988). In some hilly areas of Pakistan, where poultry farming is expanding due to favourable weather conditions, sulphur content in drinking water is as high as 600 mg/litre water (ANJUM, A. D. 1995, personal communication). Only this water is available to poultry for drinking. Poultry in this area have a continuous consumption of water with a high sulphur content, but not much was known about the effects of prolonged consumption of high sulphur content water by chickens.

Effects of sulphur on body mass, organ mass and serum proteins have been reported elsewhere (ALAM et al., 1998; ALAM and ANJUM, 1998). This

study indicates that sulphur induces significant changes in haemogram and leukogram in the chicken. Higher sulphur content in feed caused a significant decrease in the erythrocyte count (Table 1,  $P < 0.001$ ), haemoglobin concentration (Table 2,  $P < 0.001$ ), and packed cell volume (Table 3,  $P < 0.001$ ). A significant decrease in haemogram values indicates anaemia. Anaemia in these chickens was also reflected clinically as lesser mass gain (ALAM et al., 1998).

Higher concentration of sulphur in feed also induced significant changes in leukogram, i.e., total leukocyte count (Table 4,  $P < 0.01$ ) and differential leukocyte count (Table 5, Table 6). Leukocytes are an important component of cellular defence in the body (BENJAMIN, 1978). A significant decrease in total leukocyte count (Table 4,  $P < 0.01$ ) in sulphur treated chickens could adversely affect cellular and humoral defence of the body. In the present study there was a relative decrease in heterophil count, accompanied by a relative increase in lymphocytes. Contrary to this, SUN et al. (1988) reported that high sulphur levels reduced the number of lymphocytes and also affected the immunity of chicks. Since heterophils are primary phagocytic cells in blood and tissues, and lymphocytes are primary cells for humoral response, a change in the number or proportions of these cells in blood and/or in tissues, could lead to a compromised defence. Consequently, an increased susceptibility of the chicken to high challenge of pathogens under field conditions may be expected.

In conclusion, a high sulphur content in feed induced significant alterations in haemogram and leukogram values, which may have serious implications on the health of poultry.

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**ALAM, M., A. ANJUM: Učinak sumpora na krvnu sliku u Fayoumi pilića. *Vet. arhiv* 73, 39-46, 2003.**

**SAŽETAK**

Pedeset Fayoumi pilića držano je u standardnim uvjetima te hranjeno standardnim starterom u razdoblju od 55 dana. Pedeset šestog dana pilići su bili podijeljeni u pet skupina. Prva skupina je bila kontrolna. Druga skupina je dobivala 1% sumpora, treća 2% sumpora, četvrta 3% sumpora, a peta 4% sumpora u hrani. Vrijednosti hemograma uključujući broj eritrocita, koncentraciju hemoglobina te ukupan volumen stanica bile su značajno niže u skupina koje su dobivale 2%, 3% i 4% sumpora u hrani u odnosu na kontrolnu skupinu ( $P < 0,001$ ). U sklopu vrijednosti leukograma potvrđena je leukocitoza ( $P < 0,001$ ), relativna heterofilija ( $P < 0,001$ ), relativna limfocitoza ( $P < 0,01$ ) u tretiranih životinja u odnosu na kontrolnu skupinu. Promjene nisu utvrđene u relativnom broju monocita i eozinofila. Istraživanje je pokazalo da visoke doze sumpora (2%, 3% i 4%) uzrokuju promjene u hemogramu i leukogramu što može nepovoljno utjecati na zdravlje i proizvodnost životinja.

**Ključne riječi:** sumpor, pilić, krv