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Effect of Selenite on Nitrite Exchange in Chicken: A Case Study

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ABSTRACT

It was revealed that in the Tabriz region of the Islamic Republic of Iran the total amount of selenium in the poultry food and water was respectively 0.052+/-0.006 mg/kg and 0.008+/-0.001 mg/l. It is less than norm accepted in literature for poultry. That why selenium supplementation in the food allowances of poultry can positively effect on level of their productivity.
KEY WORDS: Selenium, Poultry Food, Nitrite Exchange.

1. INTRODUCTION

Poultry keeping is the one of the main fields of employment in Iran. Therefore in Iran, particularly in Tabriz region Poultry keeping demands application of new scientific achieves for providing of poultry with balanced, qualitative dietary intake and increasing of quality and quantity of egg productivity. One of the factors providing increase in poultry productivity is the using of science-based, qualitative dietary intakes allowing using physiological reserves of poultry maximally. One of the stimulants allowing increasing food quality and poultry productivity is selenium microelement. Moving in the chain are: Soil, Water, Plant, Animal and Man.

The selenium plays significant role in the life of living organisms, particularly poultry. It was revealed as a result of investigations carried out in Iran, Azerbaijan republic, USA, Ukraine, Belarus, Poland and other countries that entering into the composition of proteins, ferments of the animal organisms, selenium plays an important role in immunobiological reactions, blood forming and reproduction processes. It has been proposed that selenium may help to prevent some diseases and increase the productivity [1, 2, 3, 4, 5, 6, 7, 8]. Selenium is a naturally occurring substance that is widely but unevenly distributed in the earth's crust. Selenium levels in soil vary widely, not only in different countries but also across different regions. Its amounts in the soils are usually between 0.005 and 0,1mg/kg in many countries of the world. American and Australian soils contain much more amount of selenium (50-100 mg/kg). Animals and poultry can show the following symptoms of selenium toxicity after doses exeeding 10 mg/kg: anemia, weight loss, deformed hooves, and hair loss. The soils containing less than 0.05 mg/kg amount of selenium are considered to be soils poor in selenium. Because such

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soils could not supply the necessary amount of selenium to fodder plants. If the selenium doses received by animals and poultry are less than 0.1 mg/kg they can suffer from such diseases as liver necrosis, exudative diathesis, muscular dystrophy. The soils in the Azerbaijan Republic, in some countries of Europe, Russia are low in selenium. Researches made clear that in the Azerbaijan Republic bordered with Iran the amount of selenium used for poultry is 0.089-0.099 mg/kg. This amount do not supply the high productivity and normal activity of body [4, 7, 8]. Taking into consideration above mentioned we have set a goal to study amount of selenium in the soils of the Tabriz zone, in the food and water of poultry and using possibilies of selenium in poultry intake.

2. METHODS

Researches on determination of amount of selenium in soil, water and food (mixed fodder) were carried out in the Institute of physics, laboratory of Ecological Biophysics of the Academy of Sciences of the Azerbaijan Republic. For this purpose water, mixed fodder and soil samples were taken in the poultry- farms of the Tabriz zone. Chemical analyses were carried out by extractive-fluorimethric method using of selenium selective reagent (2,3 diaminonaphthaline) in three repetitions. After we determined the amount of selenium in feed we established the optimum norm of Se for poultry. For this purpose 0.05; 0.10; 0.20; 0.30; 0.35; 0.40 mg/kg doses of Se was added to chick diet as Na_2SeO_3. 8 experimental and 1 control groups were organized. Each group contained 100 chickens and 10 cocks. All groups were compiled from 130-140-day-old leghorn breed of chickens of same sex, age, weight and health. The chickens were placed in coops with two tiers. Experiments were finished when chickens achieved 250-260 days of age. Such indices as selenium, nitrite exchange, and sexual maturity of poultry, egg productivity, and survival and incubation quality of eggs were studied in order to determine an optimum norm. Stock of eggs was taken every day. The weight of eggs was determined weighing 10-15 eggs from each group per month. An incubation quality of eggs was determined according to eggs fertilization, hatching of chicks. For this purpose 180 eggs (20 eggs per group) were kept in the incubator. Nitrite exchange was studied determining the amount of nitrite (by the Keldal method) in the eggs, feedstuff, and excrements in 60^{th} and 120^{th} days of experiment. The amount of exposed and consumed feed was registered every day. Consumption on selenium by means of feed, using it in the chicken organism and its balance was studied according to generally.

3. RESULTS

3.1. Quantity of selenium in soil, water and poultry food in the Tabriz region

Results obtained show that amount of selenium in the studied objects is lower than that in internationally accepted norms, and it is rather lower than physiological level enough for the living organisms (Table 1).

Results of analyses were as they presented below:

1. Amount of selenium in soil samples: 0.063 +/-0.007 mg/kg.
2. In drinking water samples: 0.008+/-0.001 mg/l.

3. In mixed food samples: 0.052 +/-0.006 mg/kg

Table1: Selenium exchange in chicken organism
Groups and amount of sodium – selenite supplied

Indices	Control group	II	III	IV	V	VI	VII	VIII	IX
Consumed	0	0.5	0.10	0.15	0.20	0.25	0.30	0.35	0.40
With Feed Extracted	0.92	1.12	1.21	1.78	1.87	2.05	3.71	3.90	4.01
With Excrements Extracted	0.14	0.20	0.21	0.34	0.35	0.35	0.98	1.00	1.02
With Eggs Accumulated	0.31	0.38	0.44	0.62	0.66	0.75	1.00	1.05	1.09
In Organism,mkg	0.45	0.58	0.65	0.96	1.01	1.10	1.98	2.10	2.11
Used%	48.9	51.7	53.7	53.9	53.9	53.6	53.6	52.5	52.7

Source: the author calculations

Analysis of our results and comparison them with the literary information shows that amount of selenium in food and water consumed by poultry in the Tabriz zone makes 0.060 +/- 0.007 (in food: 0.052 +/- 0.006 mg/kg; in water 0.008 +/-0.001mg/l). This amount is lower than the norm presented in literature for poultry. These circumstances require studies of poultry dietary requirements and safe range of dietary intakes of selenium in the Tabriz zone**.**

3.2. Effect of sodium-selenite on selenium exchange in chicken organism

It was determined that sodium-selenite supplement have a positive effect on selenium assimilation causes an increase in amount of selenium in the chicken organism (Table 2).

Table2. Nitrite balance and assimilation in 60th days of experiment (per chicken within 24 hours)

Groups and Amount of Sodium-Selenite in Diet,mg/kg	Nitrite Consumed From Feed	With egg	With faces	Nitrite Balance (g)	Assimilated (g)	From Consume (d)	Consume (d) From feed	From Assimilate (d) nitrite
I control Group	2.50	0.20	1.30	+0.90	1.30	52.0	8.0	15.4
II (0.5)	2.50	0.20	1.30	+0.90	1.30	52.0	8.0	15.4
III (0.10)	2.80	1.10	0.41	+1.19	1.70	60.7	14.6	24.1
IV (0.15)	2.78	1.20	0.35	+1.08	1.73	62.2	12.5	20.3
V (0.20)	2.52	1.34	0.20	+0.88	1.28	51.0	8.0	15.8
VI (0.25)	2.56	1.37	0.20	+0.89	1.29	50.3	7.0	15.5
VII (0.30)	2.52	1.35	0.20	+0.87	1.27	50.3	7.5	15.6
VIII (0.35)	2.53	1.41	0.17	+0.85	1.22	48.2	6.7	13.9
IV (0.40)	2.50	1.40	0.15	+0.85	1.20	48.0	6.0	12.5

The amount of selenium received with feed in control group was 0.92 while in sodium-selenite supplied groups this index was 1, 12-4, 01 mkg. Maximum consumption of selenium was registered in groups receiving sodium-selenite in 0.10

mg/kg (III group), 0.15 mg/kg (IV group), 0.20 mg/kg (V group) and 0.25 mg/kg (VI group) doses. Using of selenium by organism amounted to 53.6-53-9 %. This index is more than in control group on 4.7-5.0% and in other groups (VIII-IX groups) on 1.2-1.9 %. Selenium was weakly consumed in II group only. It was more than in control group on 2.8%. We have to notice that in VIII-IX groups where chickens received the highest dozes (0.35-0.40 mg/kg) of selenium, however consumption and using of selenium was lower (52.5-52.7%) than in other groups.

3.3. Effect of sodium-selenite on nitrite exchange in chicken organism

In the first 60 days of experiment the highest level of nitrite---consumption (2.78 and 2.80 g), nitrite assimilation (1.70 and 1.73) and positive balance (1.08 and 1.19) was registered in III and IV groups (Table 3).

Table3. Nitrite balance and assimilation in 120th days of experiment (per chicken within 24 hours)

Groups Amount of Sodium-Selenit in Diet ,mg/kg	Nitrite Consumed from Feed (g)	With egg	With faces	Nitrite Balance, (g)	Assimilated (g)	From Consumed	Consumed From feed	From Assimilated nitrite
I control group	2.39	0.17	1.35	+0.87	1.14	47.8	7.1	14.9
II (0.5)	2.41	0.18	1.37	+0.86	1.14	47.3	7.4	15.7
III (0.10)	2.67	0.32	1.17	+1.18	1.60	52.8	11.9	20.0
IV (0.15)	2.66	0.30	1.21	+1.15	1.55	50.7	11.2	19.3
V (0.20)	2.40	0.16	1.42	+0.82	1.18	49.1	6.6	13.5
VI (0.25)	2.42	0.17	1.43	+.82	1.19	49.1	7.0	14.2
VII (0.30)	2.43	0.18	1.43	+.82	1.20	49.3	7.4	15.0
VIII (0.35)	2.45	0.17	1.44	+.084	1.21	49.3	6.9	14.0
IV (0.40)	2.50	0.16	1.46	+0.88	1.24	49.6	6.4	12.9

In these groups the amount of nitrite extracted with excrements is lowest, but the amount of nitrite used for one egg is highest. This fact shows that nitrite exchange is more effective in chickens of that group. Compared with control group in III and IV groups the nitrite consumption with feed (0.30-0.28g), nitrite assimilation (0.40-0.43g) and nitrite balance (0.29-0.18g) and the amount of nitrite used for one egg (6.6%-4.5%) more than nitrite consumed from feed and 7.5%-5.5% more than assimilated nitrite) was higher. In the 120th days of the experiment the nitrite consumption with feed(0. 11-0.13g), nitrite assimilation (0.06-0.13g) and nitrite balance (0.01-0.05g) is decreased, vice-versa extraction of nitrite with faces (0.05-0.07 g) is increased.

So the nitrite exchange index is higher in 190-200 day chickens than in 250-260 day chickens (tables 2 and table 3). Indices of III and IV groups in early stage of experiment were high, however later they decreased. In spite of this fact all studied indices of these groups are higher than in control and other groups in the second stage of experiment. Compared with control group the indices of the nitrite consumption with feed in these groups were 0. 27-0.28g, nitrite assimilation–0.41-0.46g and nitrite balance – 0.28-0.31g. The comparison of the results shows that increasing amount of sodium- selenite in the diet of chickens together with the decrease of nitrite consumption with feed, nitrite assimilation and nitrite balance the amount of nitrite used by eggs is decreased as well. All of these results confirm that

the high doses of the sodium-selenite have an ineffective influence on nitrite exchange. From this point of view, 0.10-0.15mg/kg doses of the sodium-selenite in the diet of the chickens have a positive influence on nitrite consumption, nitrite assimilation and nitrite balance and stimulate the egg productivity.

3.4. Effect of sodium-selenite on egg productivity of chickens and incubation quality of eggs

Analysis of results showed that doses of sodium- selenite in 0.10; 0.15 and 0.20 mg stimulate chickens to lay eggs already in 180^{th} or 182^{nd} days of age. Chickens receiving sodium-selenite in above mentioned doses begin to lay eggs in 7-9 days earlier than chickens receiving sodium-selenite in 0.5 mg/kg in the control group and in 7-9; 3-5; 5-7; 8-9 days earlier than chickens in the II;VI;VIII;IX groups receiving sodium-selenite in doses of 0.25; 0.30; 0.35; 0.40 mg/kg. It was revealed that chickens in the III, IV and V groups gave more eggs than chickens in the other groups. Within 4 months each chicken in the above mentioned groups gave 64.0-67.5 eggs whereas chickens in the control group gave 61.0 eggs each. It means that interval in the circle of egg laying in the III, IV and V groups is 1.9 days, whereas it is 2.6 days in the control group. Chickens in the VIII and IX groups received the highest doses of sodium – selenite (0.35–0.40 mg/kg) laid the minimum number of eggs. The number of eggs laid by the chickens in the mentioned groups was less than in control group. It can be explained by the negative effect of high doses of sodium–selenite on egg productivity of chickens. It was revealed that sodium-selenite supplement does not have a considerable effect on egg mass increasing and total mass of eggs received per chicken. There is no any difference among experimental groups and control groups ($P<0.05$). In contrast to egg mass, sodium-selenite has a significant effect on general condition and survival of chickens. Thus chickens from majority experimental groups had good appetite, smooth and shining feather and light red comb. During the experimental period (4 months) survival of the chickens from III, IV, V, VI, VII experimental groups was 1.8-3.0% more than in control groups. Comparing with control group the percent of survival was high ($P<0.5$) in chickens from the III, IV and V groups. Results obtained show that sodium-selenite supplements had positive influence on fecundation of eggs in experimental groups. Comparing with control group the level of fecundity was 2-3% higher in experimental groups. There are some differences in the indices of hatching of chickens from eggs. It was 0.7-1.4% higher in III, IV, V and VI experimental groups than in control group. This index was positive in III, IV and V groups only ($P<0.5$)**.**

4. Conclusion

Analysis of the indices obtained as a result of researches for determination of norms of sodium- selenite for chickens allowed drawing the following result: It was revealed that 0.20 mg/kg sodium-selenite effectively influence on nitrite and selenium exchange in organism, egg productivity, chickens survival, incubation quality of eggs. 0.20 mg of sodium–selenite (Na_2SeO_3) contains 0.10 mg pure selenium. If the amount of selenium received with water (0,008 mg/l) and food (0.052mg/kg) is added to the above mentioned amount the total amount of selenium in the chicken diet will be 1.16 mg. This amount meets the selenium requirements of chickens. Se 0.20 mg/kg doze of

sodium-selenite is the optimum for chickens in the Tabriz region.

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