

Effects of sodium bicarbonate, potassium chloride and sodium chloride supplementation on some blood biochemical parameters in laying hens.

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This research was carried out to determine the effect of supplementation of sodium bicarbonate (% 0.38, % 1.5), potassium chloride (% 0.7) and sodium chloride (% 0.25) at different levels in diets of 480, 25-week old laying hens on blood plasma Ca, Pi, Mg, Cl, Na, K, total protein, albumin and uric acid levels. During the 90-day trial, animals were divided into eight groups, 60 animals in each. Then each group was divided into six subgroups, 10 animals in each. Animals had access to ad libitum feed and water. At the end of the experimental period, blood samples of six chicks from each group were collected into heparinized tubes and plasma were separated by centrifugation at 2500 rpm for 10 min at +4 C°. Na and K concentration were quantified by flame photometry and Ca, Pi, Mg, Cl, total protein, albumin and uric acid concentration were measured by spectrophotometry. Data was analysed using variance analysis and Duncan Multiple Range Test. Supplementation of diet with sodium bicarbonate, potassium chloride and sodium chloride did not affect plasma Ca and uric acid concentrations between control and treatment groups. However, Pi, Mg, Cl, Na, K, total protein, and albumin concentrations differed statistically among groups due to the diet supplementations.

As a result, in laying hen diet, supplementation of sodium bicarbonate, potassium chloride and sodium chloride either alone or combined caused important changes in some biochemical values. Detection of interaction among minerals warrants further investigations.

Key Words: laying hen; sodium; potassium; chloride; biochemical parameters.

Introduction

Sodium (Na), potassium (K) and chloride (Cl) are important and beneficial elements for human and animal nutrition because of cheapness and metabolic effects on biochemical reactions such as acid-base balance, regulation of osmotic pressure, absorption of amino acid and monosaccharide and neuron function of them. These metabolic effects of Na, K and Cl provide optimum performance on domestic animals especially in layers (Mc Dowell, 1992; Murakami et al, 2001). These elements are required for yield performances in layers such as egg production, shell quality, feed and water intake, weight gain (Murakami et al, 2001). It was reported that supplementation of K (0.6%) into poultry diets provides the positive effects on heat stress (Deetz and Ringrose, 1976). Mineral concentrations of nutrients are also important factor for determining of supplement mineral levels. For example, when soybean meal which have high K level were used in rations, K additions may be not required (Kurtoglu et al, 1998; Smith et al, 2000). Certainly mineral intakes with ration or drinking water affect the blood biochemical profiles (Johnson and Karunajeewa, 1985). Because Na, K, Cl are exactly important minerals intra and extracellular fluid and function to maintain cation-anion balance (Mc Dowell, 1992). Also mineral elements can not be synthesised by live organisms. For this reason, minerals are essential nutrients (Smith et al, 2000). Insufficient or excessive intakes of minerals by

nutrients or supplemental agents cause synergistic or antagonistic effects on each others and its affect the mineral haemostasis. For instance, hyperkalemia in acidosis may be formed by mobilising intracellular K ions to extracellular fluid. Likely, excess absorbtion of Na may be caused the hyperkalemia (Kalaycioglu et al, 2000). Hyponatremi has been especially formed by excess Na (up to 0.30%) supplementations such as NaCl and NaHCO₃ combination used in poultry rations (Mc Dowell, 1992; Oviedo-Rondon et al, 2001). In this cases, several symptoms such as excess water intake, diarrhea, decreases in yield performances and visceral gout can be formed in poultry (Davison and Wideman, 1992). Also, excess Na intake may be cause K deficiency in animals. Using low K in experimental diets, the main K deficiency sign in poultry is an overall muscle weakness, increases in water intake (Damron and Kelly, 1987), poor egg production (Choi and Han, 1983; Harms, 1991; Harms et al, 1995), and impaired protein synthesis (Mc Dowell, 1992). High feces humidity is an important factor because of increasing viral and bacterial infection risk on the poultry industry.

The aim of this study was to investigate the effects of Na, K and Cl supplements on blood mineral and other biochemical parameters of laying hens.

Materials and methods

In this study, a total of 480, 25 weeks old, Brown-Nick layer hens housed in Animal Research Institute were used. Layers were weighted individually and divided into 8 main groups of 60 layers each. To limit the position differences, these groups were each divided into 6 subgroups of 10 chicks each. Each subgroup consisted of 2 cages, each of which was 55x45x40 cm in dimensions. Food and drinking water were provided *ad libitum*. Experimental period was lasted at 90th day. Composition of experimental ration and levels of supplemental NaCl, KCl and NaCO₃ according to the groups were shown in *Table 1*. On day 30 of the period, there was an increased mortality in the group 1 and 2 and 0.25 % Na was added in to the rations of first 4 groups. For plasma analysis, blood samples were taken from 6 layers in each group by *cardiac pucture* into heparinised (10 IU heparin ml/blood, *Liquemine flacon, Roche, Turkey*) tubes on 90th day. Obtained blood samples were immediately centrifuged (*Megafuge 1.0 R HERAEUS Sepatech GmbH*) at 1000 g for 15 min at +4 °C. There was no mortality as a result of heart puncture. Plasma calcium (Ca), inorganic phosphorus (Pi), magnesium (Mg), chloride (Cl), total protein, albumin and uric acid levels were measured with a spectrophotometer (*Shimadzu, UV 2100, Japan*) by using commercial kits. Plasma Na and K amounts were determined by the flame photometer (*Jenway PFP 7, UK*). Data belonging to the biochemical parameters were measured individually and analysed by using Duncan's multiple range test (SPSS, 1998).

Results and discussion

All biochemical parameters obtained from groups were shown in *Table 2*. In this study, main supplements were Na, K and Cl. Plasma Na, K and Cl concentrations (*Table 2*) increased in closely related manner to the dietary Na, K and Cl concentrations. Mortality that was observed in the groups 1 and 2 was possibly due to that NaCl and KCl were not added to the diets or that NaHCO₃ was used as source of Na. It is because Na > 0.30 % will eventually cause a Cl deficiency in the blood and kidneys. It should be explained if NaCl is used as a source of Na, Cl deficiency will be not so detrimental. Sauveur and Mongin (1978) reported that, Na deficiency (0.5g Na/kg) increased the symptoms of Cl deficiency (0.8 g/kg) but supplementation of 12 g/kg K improved the symptoms of Cl deficiency. This indicates that if Na and Cl were added in high amounts, addition of K in high amount will be detrimental. In this study, we found the statistical difference in Na, K and Cl (P<0.001) between the groups; it may be said that these statistical difference may be related to the several supplementation levels of Na, K and Cl in to groups. However, in this experimental study, all mineral supplements were made in limits recommended by NRC (1994). Reece et al (2000), found that 0.54, 0.57, 0.74 and 0.84% K additions in to turkey rations affected the plasma Na, K and Cl, these findings of authors (Reece et al, 2000) are agreed with the our reports. Authors (Reece et al, 2000) reported that some

important factors such as centrifugation procedures, ambient temperature and storage directly affect the blood K concentrations.

Table 1. Composition of diets according to groups

Nutrients	Groups							
	1	2	3	4	5	6	7	8
Corn	51	51	51	51	51	51	51	51
Wheat	10	8.33	9.83	9.45	10.05	7.98	9.58	8.8
Soybean meal	24.50	25	24.50	24.50	24.50	25	24.50	24.70
Meat-bone powder	1	1	1	1	1	1	1	1
Olive oil	1.65	2	1.80	1.80	1.65	2.1	1.8	2
Limestone	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Dicalcium phosphate	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Mineral premix 1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vitamin Premix ²	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NaHCO ₃	0.38	1.5	0	0.38	0.38	1.5	0	0.38
KCl	0	0	0.7	0.7	0	0	0.7	0.7
NaCl	0	0	0	0	0.25	0.25	0.25	0.25

¹Mineral premix: In each kg; Mn 80.000 mg; Fe 35.000 mg; Zn 50.000 mg; Cu 5.000 mg; I 2.000 mg; Co 400 mg; Se 150 mg ²Vitamin premix: In each 2.5 kg; retinol 12 000.000 IU; Vitamin D₃ 2 000 000 IU, Vitamin E 30.000 mg; Vit K₃ 3.000 mg; Vit B₁ 3.000 mg; Vit B₂ 6.000 mg; Vit B₆ 5.000 mg; Vit B₁₂ 15 mg; Niacin 25.000 mg; Biotin 40 mg; Carotenoid 8.000 mg; Folic acid 1.000 mg; Cholin chloride 300.000 mg; Vit C 50.000 mg.

Table 2. Biochemical parameters obtained from groups and statistical evaluation

Groups	Parameters								
	Ca (mg/dl)	Mg (mg/dl)	Pi (mg/dl)	Cl (mmol/l)	Na (mg/dl)	K (mg/dl)	Total protein (g/dl)	Albumin (g/dl)	Uric acid (mg/dl)
1	12.16±1.15	0.82 ±0.16 ^b	7.06±0.49 ^c	111.61±4.91 ^{ab}	359.50±5.80 ^b	15.55±1.81 ^d	3.14±0.24 ^{de}	2.62±0.45 ^d	6.79±0.76
2	11.79±1.40	0.86 ±0.27 ^b	6.80±0.62 ^c	102.50±3.36 ^b	420.67±17.9 ^a	18.83±1.27 ^{cd}	2.23±0.17 ^e	2.50±0.22 ^d	5.95±0.81
3	9.91±0.65	1.23±0.36 ^b	9.45±0.63 ^{ab}	119.27±4.99 ^{ab}	299.83±22.76 ^c	33.27±0.91 ^a	4.11±0.39 ^{cd}	3.60±0.26 ^{bc}	8.55±0.80
4	13.76±0.65	2.67±0.55 ^a	9.83±0.46 ^{ab}	118.51±10.52 ^{ab}	381.83±11.77 ^{ab}	25.33±0.91 ^b	4.35±0.31 ^c	4.78±0.31 ^a	6.04±1.00
5	12.72±0.71	1.77±0.14 ^{ab}	9.66±0.96 ^{ab}	129.05±8.07 ^b	352.67±27.34 ^b	28.48±2.01 ^b	3.44±0.38 ^{cd}	2.94±0.17 ^{cd}	5.74±1.03
6	12.42±0.94	0.81±0.19 ^b	8.84±0.89 ^{bc}	134.05±9.18 ^a	425.67±27.34 ^a	19.93±1.52 ^c	3.30±0.24 ^{cd}	3.43±0.27 ^c	5.36±0.82
7	12.54±0.39	1.79±0.50 ^{ab}	11.64±0.99 ^a	137.25±13.08 ^a	352.17±2.10 ^b	26.93±1.09 ^b	6.29±0.38 ^b	4.38±0.31 ^{ab}	4.74±0.56
8	13.71±1.35	1.62±0.22 ^{ab}	11.53±0.75 ^a	132.80±6.18 ^a	364.40±4.82 ^b	25.58±0.74 ^b	7.97±0.63 ^a	4.90±0.24 ^a	5.68±0.81
P	0.160	0.003	0.000	0.045	0.000	0.000	0.000	0.000	0.094

Means within columns with no common superscripts differ significantly.

Total protein and albumin concentrations were found statistical significance ($P < 0.001$) in this study. In the groups 1, 2, 5 and 6 which did not receive KCl addition, low total protein and albumin levels found in these groups may be reflect the concept that protein synthesis may be impaired by K deficiency in poultry (Mc Dowell, 1992). However, plasma K concentrations of groups 1,2,5 and 6 were in normal range because of using soybean meal that have high K level in the main ration. And also, plasma K concentrations in K supplemented groups were increased but not reflect sign in hiperkalemia. There was no any statistical difference in uric acid and Ca levels between the groups.

In conclusion, evidence from this study suggests that NaCl, KCl, and NaHCO₃ alone or combined supplementations have an important biological role that influences mineral metabolism of the layers by biochemical mechanisms. But, further research is needed in order to observe the interaction between minerals required to obtain maximal beneficial effects on metabolism of laying hens.

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