INFLUENCE OF LEAD AND CADMIUM ON PRODUCTIVITY OF LAYING-HENS

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SUMMARY

Investigation was conducted with 80 layers of ISA-Brown divided in 4 groups in 36 week age. The animal ration includes different amount of lead and cadmium: group 1-the amount of tow toxic elements is under the MRL. The amount of tow toxic elements in group 2, 3 and 4 is 10, 100, 1000 times bigger than MRL respectively.

Influence of lead and cadmium on productivity of laying-hens was studied. Decrease egg production, egg weight, eggshell weight, weight of yolk and albumen and consumption of fodder are established for high concentration of lead and cadmium. For low and median dose of lead and cadmium increase of egg production and decrease of consumption of fodder for 1 kg egg are noted.

Keywords: cadmium, lead, eggs, hens, productivity

INTRODUCTION

Cadmium, an environmental pollutant is well to have a serious biological toxicity, and there have been many studies suggesting it to be the cause of "Itai-Itai disease" (Mochizuki et al 2002).

Lead is considered one of the major environmental pollutants; the effect of Pb on chicken, dove and wild animals is well-documented (Baykov et al 1996, Dong-Ha et al 2002, Medvedev et al 1999). Furthermore the ingestion of Pb by laying birds will result in an increase of Pb concentrations in eggs (Jeng et al 1997, Burger et al 2001). Information on the effect of Pb and Cd on laying hens is not available.

The objectives of this experiment were to investigate influence of lead and cadmium on productivity of laying-hens include laying capacity, egg mass, weight of egg, weight of white and yolk and weight of egg-shell.

MATERIALS AND METHODS

Investigation was conducted with 80 hens of ISA-Brown's breed divided in 4 groups in 36 weeks age. The four groups are equalized by origin, sex and biomass. The birds ration includes different amount of lead and cadmium:

1. Group I-the amount of the tow toxic elements is under the MRL (Maximum Residues Limit).
2. Group II-the amount of the tow toxic elements is 10 times bigger than MRL.

3. Group III-the amount of the tow toxic elements is 100 times bigger than MRL.
4. Group IV-the amount of the tow toxic elements is 1000 times bigger than MRL

Eggs were collected daily and laying capacity, weight of the egg, eggshell yolk and white were calculated every 15 days. Experiment continued 90 days.

For statistical analysis Origin® 7.0 SR0, V 7.0220 (B220) and Excel were used. The following variations of the analysis of variance (ANOVA) test were used for analysis of data. The criterion for significance was $P < 0.05$

RESULTS AND DISCUSSION

At analysis of results connected with laying capacity (table 1) were showed, that laying capacity decrease after first 15 days of experiment, which begin with 76.7% in control group and decrease to 74.3, 67.3 and 57% in II, III and IV respectively. After this time laying capacity decrease gradually and reach to 60.3% at 90 days. At higher dose of the Pb and Cd, lying capacity decrease in end the experiment to 15.1%. Similar results were obtained at dose of Cd 50 and 100 ppm (NRC 1980). In II group laying capacity increase comparatively with control group and reach at day 90 to 89.7%. Laying capacity in III group increase to middle of experiment (60 days) and decrease to end of the experiment.

Table 1. Laying capacity every 15 days (%)

Group	15	30	45	60	75	90	General medium
I	76,7±13,7	81,7±7.7	73 ±11.9	64,3 ±12.2	66,3 ±8.8	60,3±11.0	70,38±8.1
II	74,3±14,6	79,3±10.2	81,7±12.5	83,3 ±5.2*	86,7±5.2*	89,7±3.9*	82,5 ±5.4*
III	67,3 ±12,5	84,7±5.5	87,3±10.0*	87,7 ±5.3*	80,3±9.0*	79,7±5.6*	81,2 ±7.6*
IV	57±10,0*	56,3 ±9.7*	36,7±11.6*	47,7±10.2*	27,7±9.4*	15,1±10.0*	40,08±16.7*

* significantly comparison with control group ($P < 0.05$)

Similar tendency at analysis of the results connected with egg mass is established (table2). Increase of the dose lead to decrease of egg mass only after the first 15 days. In the IV group decreasing of the egg mass vastly continued to end of the experiment, while in the II group egg mass increase gradually to end of the experiment. In the III group the egg mass increase to middle of the experiment (60 days) and decrease to end of the experiment. General egg mass in the end of experiment for all groups is 80.7, 92.9, 91.4 and 43.7 kg respectively.

Table 2. General egg mass every 15 days (kg)

group	15	30	45	60	75	90	General mass	General medium
I	14.61	15.51	13.97	12.49	12.58	11.50	80.66	13.44±1.50
II	13.79	14.80	15.36	15.80	16.29	16.84	92.88	15.48±1.09*
III	12.38	15.88	16.64	16.71	15.03	14.75	91.39	15.23±1.62
IV	10.47	10.24	6.69	8.70	5.05	2.56	43.71	7.29±3.27*

* significantly comparison with control group ($P < 0.05$)

Important index is expense of the fodder for 1 kg egg mass. In the II and III expense of the fodder is 2.70 and 2.74 kg/kg egg mass, while in the control group is 3.09 kg. In the IV group expense of the fodder is 5.03 kg. Finley et al (1976) show that add of the lead to fodder of the duck with dose of 1, 5, and 25 ppm no lead to reliable difference in the consumption of the fodder after 12 month. Negative effect of the Pb and Cd on the productivity of the hens is established at analysis of the weight of egg, white, yolk and eggshell.

Medium egg weight decreased in to direction: at increase of the dose and continued time of the feeding (table 3). Medium egg weight in the control group was kept to end of the experiment (Jan et al 2004). General medium egg weight for I, II, III and IV is 63.68, 62.53, 62.49 and 60.66 g respectively. Similar tendency is noted at add Pb and Cd with tow dose low: 6.7 and 5.1 mg/l water respectively and high dose: 67 and 50 mg/l water respectively (Vodela et al 1997).

Table 3. Medium egg weight every 15 days (g)

group	15	30	45	60	75	90	General medium
I	63,51±3.77	63,3±4.96	63,8±3.31	64,7±3.00	63,21±4,6	63,55±3,44	63,68±3,85
II	61,84±5.91	62,2±4.53	62,7±3.11	63,2±4.36	62,64±4,24	62,6±4,02	62,53±4,36*
III	61,31±3.75	62,5±3.44	63,51±3.18	63,54±2.12	62,36±2,63	61,71±2,86	62,49±3,00*
IV	61,21±3.86	60,6±6.55	60,85±5.55	60,82±4,79	60,9±6,12	59,55±5,93	60,66±5,47*

* significantly comparison with control group ($P < 0.05$)

Same tendency is noted at study of the white and yolk weight (table 4).

Table 4. Medium white and yolk weight every 15 days (g)

Group	15	30	45	60	75	90	General medium
I	57,1	56,3	57,3	57,8	56,3	56,6	56,9±0.60
II	55,9	55,8	56,5	56,6	56,1	56,2	56,2±0.32*
III	55,4	56,3	57,4	57	56,3	55,7	56,3±0.76
IV	55,3	55	54,5	54,6	55	54,1	54,8±0.43*

* significantly comparison with control group ($P < 0.05$)

Influence of Pb and Cd is clear at study of the eggshell weight. Medium eggshell weight decrease at increase of the dose and at continued time of the feeding with exception of II and III groups after 60 days, where eggshell weight little decreased in comparison with previous periods (table 5).

Table 5. Medium eggshell weight every 15 days (g)

group	15	30	45	60	75	90	General medium
	6.37	6.99	6.52	6.89	6.91	6.93	6.77±0.25
	5.91	6.42	6.21	6.65	6.54	6.40	6.36±.026*
	5.92	6.23	6.11	6.54	6.10	6.01	6.15±0.23*
	5.95	5.58	6.33	6.19	5.90	5.50	5.90±0.33*

* significantly comparison with control group ($P < 0.05$)

These results maybe connected with metabolism disturbance of calcium in the bird's organism. This be confirmed from Vodela et al (1997) which indicate that add Pb with dose 200 ppm lead to decrease laying capacity and calcium metabolism disturbance.

CONCLUSION

Applying of the Pb and Cd in dose 10, 100 and 1000 time bigger than MRL lead to phasic effect on productivity of the hens and consumption of the fodder. Low dose of the Pb and Cd (II and III) lead to rise of laying capacity and received egg mass at low fodder expense. High dose of the Pb and Cd (IV) lead to decrease productivity and increase fodder expense.

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