The Effect of Experimental 17-beta Estradiol Administering on Calcium Metabolism Regulation in Young Laying Hens

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Abstract

Three groups of 128-day-age laying hens were i.m. injected with 17-beta estradiol for eight days, in different doses, vs. an untreated control group. Calcium from ingesta, egg shell, feces and mineral bone content was determined. At the end of the experimental treatment, the results showed an increase in the egg yield in all treated hens vs. control, between 6% and 8% depending on the estradiol dose, but not proportionally to the dose of estrogen administered. The amount of daily absorbed calcium was (in g): 0.97 in control while in estrogen treated groups the values ranged between 1.37 and 1.77. Calcium concentration of the egg shell and total calcium content of the egg shell was not significantly influenced. The daily mean amount of calcium excreted by egg was increased vs. control. Blood calcium values ranged between 5.65 and 7.16 meq/100 mL vs. 4.45 meq/100 mL plasma in control ($P = 0.0081$). The amount of the mineral content of the bone increased while calcium excreted in the feces and urine was less than in control. Blood levels of calcitonin, parathormone, progesterone and calcitriol were found modified, relatively proportional to the administered amount of estrogen.

Keywords: *calcium metabolism regulation, estradiol, laying hens.*

INTRODUCTION

Calcium metabolism regulation in laying hens involves a complex of biochemical, nervous and hormonal factors. One of these factors is represented by the estradiol. Usually it is accepted that estradiol is synergic to parathormone in laying hens but the exact role of this hormone in the regulation of the calcium metabolism in laying hens isn't well understood (Hafez, 1993; Bentley *et al.*, 1998; Dojana *et al.*, 2014).

AIMS

The aim of this research was to find out the exact role of the estrogen in the regulation of the calcium metabolism in laying hen at the beginning of the laying cycle, when a lot of hormonal events

develops according to the installation of the puberty and the starting of the laying cycle.

MATERIAL AND METHODS

Three group of 128-day-age ROSSO laying hens noticed as A, B and C were i.m. injected with 17-beta estradiol in different doses (IU/cap./day): 12,500 in group A, 25,000 in group B and 50,000 in group C. The all experimental treatment lasted for 8 days. Calcium content from ingesta, egg shell, feces and mineral bone content were determined in the three experimentally treated groups vs. an untreated control group. Fodder, feces, eggshell and bone samples were calcinated at 500°C. Calcium from the resulted mineral samples was analyzed according to Predtecschi *et al.* (1953) cited by

Tab.1. Blood plasma levels of the main hormones involved in regulating of calcium metabolism in ROSSO hens, 128 days aged, treated with 17-beta estradiol for 8 days (pg/mL)

Hormone	Control	Group A	Group B	Group C	P (ANOVA)
Calcitonin	220.5±12.0	230.0±19.0	234.8±14.0	226.1±22.2	0.0390
Parathormone	77.9±3.2	55.5±4.3	44.5±3.5	40.0±2.4	0.0492
Progesterone	30.0±2.8	67.8±4.5	73.5±4.4	81.9±5.5	0.0018
Calcitriol	140.5±7.0	178.5±15.5	166.6±11.0	190.5±16.5	0.0098

Manta (1976). The plasma levels of estradiol and the main hormones potentially involved in the calcium metabolism regulation were measured at the end of the experimental treatment period for the experimental and control groups using a COBAS e 411 ANALYZER. The results were processed statistically by ANOVA-single-factor test and the null hypothesis was rejected for $P < 0.05$.

RESULTS AND DISCUSSION

According to the results, it was found an increase in the egg yield of estradiol-treated hens vs. control, between 6% and 8% depending on the group, not proportionally to the dose of estrogen administered.

The amount of daily absorbed calcium was (in g): 0.97 in control while in estrogen treated groups the values were 1.37 (group A), 1.54 (group B) and 1.77 (group C). Estrogen treatments did not significantly influence the concentration of calcium in the egg shell or calcium content per whole egg shell. The daily mean amount of calcium lost was (in mg): 528.5 in group A, 487.2 in group B and 468.2 in group C vs. 405.0 in control ($P = 0.0250$). Blood calcium values ranged between 5.65 and 7.16 meq/100 mL vs. 4.45 meq/100 mL plasma in control at the end of the experimental period ($P = 0.0081$). The amount of daily absorbed calcium ranged between 1.37 and 1.77 in experimentally treated groups vs. 0.97 in control. Calcium excreted in the feces and urine was (in mg/g dry matter of feces) was as it follows: 1.87, 1.68 and, respectively, 1.60, vs. 2.15 in control. The mineral content of the bone was 390 mg ash/g of calcinated tibia bone in control vs. 439, 472 and, respectively, 460 mg ash/g of tibia bone in experimental treated groups ($P = 0.0332$). Regarding bone mineral content, Barr and Hurwitz (1987) reported values of 2.830 mg / tibia bone in chickens and 2,250 mg / tibia bone in hens fed

by low calcium diet. Beighle *et al.* (1995) reported content amounted to 59.2% of ash in the ribs of cow. Blood levels of calcitonin, parathormone, progesterone and calcitriol were found modified, according to the data from Tab.1. It was found a high level of calcitriol in the estrogen treated groups, which is in agreement with Gallagher *et al.* (1990): in birds, estrogen administration increases the conversion of calcidiol in calcitriol. According to some research data, the estrogen hormones are not considered traditionally calcitropic hormones because their influence on extracellular calcium appears to be more indirect, although they are directly involved in calcium homeostasis in a number of vertebrate species. In avian species, however, calcium homeostasis is closely related to ovulation and reproductive hormones. Onset of sexual maturity in White Leghorn laying hens increases plasma estradiol levels, total blood calcium and duodenal absorption of calcium (Hurwitz *et al.*, 1973; Elaroussi *et al.*, 1993, cited by Hansen, 2003). Many researchers including Corradino *et al.*, 1993; Bluhm *et al.*, 2003; Hansen, 2003; Senior, 2004 reveals effects of estrogens on intestinal epithelium, as direct stimulation of calcium absorption, or stimulatory effects on the secretion of other hormones, such as calcitriol.

CONCLUSION

Experimental estrogen treatment showed the involvement of this hormone in the regulation of the calcium metabolism in laying hens, being responsible for an increase in calcium absorption, an increase of eggshell calcium exports and an increase of calcium deposition in bones. Blood plasma levels of calcitonin, parathyroid hormone, progesterone and calcitriol are modified accordingly.

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