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Effect of Epinephrine and Bromocriptine on Ovary Folliculogenesis and Productive Traits of Laying Hens

Short Communication

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ABSTRACT

An experiment was conducted to study the effect of Epinephrine (EP) and bromocriptine (BR) on productive traits of laying hens. Thirty White Leghorn hens, 50 weeks old, were divided into three equal treatments (with 10 hens for each treatment): control, physiological serum (0.5 mL/hen/week), EP (0.5 mL/hen/week) and BR (100 g/kg of body weight (BW); w/v in absolute alcohol). Hens were injected once a week for 10 weeks. At the end of the experimental period, all hens were killed by decapitation. Ovaries, oviducts and ovarian follicles were examined. Ovary folliculogenesis was affected (P<0.01) by EP and BR treatments. There were larger yellow follicle (LYF), smaller yellow follicle (SYF) and larger white follicle in EP and BR treated hens compared to control group respectively. EP and BR treatments shortened total pause length compared to control (P<0.01). Mean weekly egg production was higher (P<0.01) for treated hens with BR and EP compared to control group. Percentage of weekly egg production was higher (P<0.01) in treated birds compared to control group. It can be concluded that EP and BR may promote ovarian follicular development and stimulate ovulation in laying hens at the end of their reproductive cycle.

KEY WORDS bromocriptine, egg production, epinephrine, laying hens, ovarian follicles.

INTRODUCTION

Egg production rate is a positive economical factor in commercial laying hens. In egg industry, the only source of income is the number and weight of eggs laid in a laying cycle, therefore, researchers have been trying to find approaches to increase the egg number in each laying cycle. In general, a hen lays eggs in clutches with a pause of one or a few days in between the clutches (pause days). The exact physiological mechanism involved in taking a pause between the sequences is not fully understood. In fact, it has been considered that increasing concentration of prolactin (PR) plays a role in the cessation of egg laying and broodiness during the active period of lay (Lea *et al*. 1981; Sharp *et al*. 1998). Li *et al.* (2011) indicated that immunization against PR slows down ovarian follicular development and reduced hen egg-laying performance, suggesting that PR plays a stimulatory role in ovarian follicular development in laying hens. Probably prolactin acts at all levels of the hypothalamus-hypophysis-gonadal axis and inhibits reproductive function (Camper and Burke, 1977). It has been suggested that an increase in plasma PR concentration during the incubation period may decrease luteinizing hormone (LH) secretion (Sharp *et al.* 1998).The secretion of PR from the anterior pituitary gland is regulated by dopamine. Dopamine inhibits the stimulatory action of vasoactive intestinal peptide (VIP), a PR releasing hormone, through receptors (D2), thereby decreasing the PR secretion to overcome broodiness in chicken (Sharp *et al.* 1989). Reddy *et al*. (2001) demonstrated that the use of bromocriptine, a dopamine agonist, during early life (from 17 to 36 weeks of age) of White Leghorn hens resulted in an

increment of egg production during treatment and a decrease in PR blood concentration. Epinephrine (EP) and norepinephrine (NE) function as neurotransmitters and hormones in the chicken, binding to a- and b-receptors, which have greater relative sensitivity to EP than to NE (Denno *et al*. 1994). In the hypothalamus, an involvement of catecholamines in the preovulatory gonadotropin surge via regulating GnRH neurons within the brain has been proposed for many years. Specifically, an adrenergic mechanism is implicated in the stimulation of LH release and ovulation (Yang *et al*. 2000). Elevation in catecholamines only occurs during ovulation and preovulatory LH surge. Catecholamines may have some roles in ovulation (Ebeid *et al*. 2008). Previous studies were conducted during the active period of egg lay in domestic hen where pause days occur with less intensity than the older hens, in this context, this experiment was conducted to study the role of EP and BR in regulating ovarian follicular development, folliculogenesis, and ovulation during the later stages of the egg laying period.

MATERIALS AND METHODS

A total of thirty White Leghorn, 50 weeks old, weighing 1.73 ± 0.10 kg were divided to three treatments with 10 hens for each treatment. Hens were provided with commercial corn-soybean meal feed (17% CP; 2850 kcal ME/kg diet) and fresh water *ad libitum*. Treatment groups consisted in control, physiological serum, (0.5 mL/hen/week), EP (0.5 mL/hen/week) and BR (100 µg/kg of BW; w/v in absolute alcohol). At 50 weeks of age, bromocriptine treated hens were given 1 mL of bromocriptine solution dissolved in absolute alcohol at 100 µg/kg body weight/week/bird through subcutaneous (sc) route underneath the wing at weekly interval from 50 to 70 weeks of age, as described by Reddy *et al*. (2007). Control hens were administered with 0.5 mL physiological serum. For EP treated hens, EP was dissolved in saline immediately before injection. For these two treatments, injections (0.5 mL) were administered into the left and right thigh muscle alternatively as described by Ebeid *et al*. (2008).

Total egg production, egg production rate, pause days between the ovulatory sequences, and differences in lay rates between two groups from 50th to 70th week of age were recorded. After 70th week, all hens were sacrificed. The abdominal cavity was opened to abstract the ovary and oviduct. Number of normal large yellow follicles (LYF) (>10 mm diameter), Number of small yellow follicles (SYF) (5-10 mm diameter), and large white follicles (LWF) (3-5 mm diameter), were recorded. Follicular size classifications were based on the suggestions by Renema *et al*. (1995).

All data were analyzed by one-way analysis of variance (CRD) by using proc GLM of the SAS software (SAS, 1996). The rate data were transformed into arcsine but actual values are reported.

Treatments means were compared among the groups using Tukey procedure and values were presented as LS Means ± SE (P<0.05).

RESULTS AND DISCUSSION

The data for mean weekly egg production, egg production rate and egg production pause length was shown in Table 1. Mean weekly egg production did not differ between hens from 51 to 70 weeks of age. But treatment with BR (5.35±0.16) and EP (5.26±0.16) increased (P<0.01) mean weekly egg production compared to control group (4.25±0.16).

Table 1 Weekly egg production, pause length and egg production for epinephrine and bromocriptine treated white leghorn hens (n=10)

Trait	Control	Epinephrine	Bromocriptine
Egg weekly production	4.25±0.16^{b}	5.26±0.16^{a}	5.35±0.16^{a}
Egg production (%)	68.01±0.42^{b}	71.39±0.42^{a}	71.48±0.42^{a}
Pause length (days)	2.30±0.15^{b}	1.62±0.15^{a}	1.36±0.15^{a}

The means within the same row with at least one common letter, do not have significant difference (P>0.01).

Weekly egg production rate was not different between hens from 51 to 70 weeks of age. EP (71.39±0.42) and BR (71.48±0.42) treatment had significant effect (P<0.01) on weekly egg production rate compared to control group (68.01±0.42).

Egg production pause length was not significantly affected by age of hens, but EP (1.62±0.15) and BR (1.36±0.15) treatments shortened total pause length for treated birds compared to control group (2.3±0.15).

Ovary folliculogenesis was affected (P<0.01) by EP and BR treatments (Table 2). There were more LYF (3.6±0.28 and 4.3±0.28 *vs*. 2.6±0.28), more SYF (4.8±0.35, 4.6±0.35 *vs*. 3±0.35) and more LWF (15.8±0.45, 15.4±0.45, *vs*. 13.00±0.45) for EP, BR and control hens respectively.

Table 2 Effects of epinephrine and bromocriptine on the number of different follicles of White Leghorn hens (n=10)

Trait	Control	Epinephrine	Bromocriptin
LWF	13.0±0.45^{b}	15.8±0.45^{a}	15.4±0.45^{a}
SYF	3.0±0.35^{b}	4.8±0.35^{a}	4.6±0.35^{a}
LYF	2.6±0.28^{b}	3.6±0.28^{a}	4.3±0.28^{a}

LWF: large white follicle; SYF: small yellow follicle and LYF: large yellow follicle. The means within the same row with at least one common letter, do not have significant difference (P>0.01).

In laying hens, egg production decreases simultaneously with advancing age and this is particularly marked later in the reproductive period due to more inter sequence pause days. The physiological mechanism responsible for pauses between the sequences of egg laying is not fully explained.

The present study compared the effect of BR or EP injection on egg production in later stages of the egg laying period. Both treatments decreased pause length and increased not only weekly egg production but also egg production rate. It has been shown that PR neutralization would lead to longer ovulatory sequences and increasing egg production (Reddy *et al.* 2001). Similar result was found in an earlier study in which, PR concentration decreased in BR treated birds (Reddy *et al*. 2005).

Reddy *et al*. (2007) demonstrated a shift from a low functional state to a high functional state during 72-82 weeks of age following BR treatment in domestic hens. The authors reported an increase in plasma concentrations of progesterone (P4), estradiol (E2) and LH within 3-4 weeks following BR treatment. High concentration of LH has previously been shown to be associated with the initiation of egg production. Plasma concentrations of LH declined in laying period of hens as age increased, decreasing egg production, and increasing inter sequence pause days. It has been reported that old laying broiler breeder hens have lower plasma concentrations of LH and reduced pituitary responsiveness to the chicken LH. Blocking of PR with BR, enhanced reproductive performance of the old laying hens by reducing the number of pause days and shortening the reflected ovulation cycle (Reddy *et al.* 2007).

It is obvious that control of folliculogenesis is a very complex physiological system. The mechanisms that regulate the follicular phases, and the growth and development of follicular cells, have not been fully identified. Folliculogenesis in domestic hens appears to be controlled by numerous factors, particularly the gonadotropins, LH and follicle-stimulating hormone (FSH). Number of eggs laid by a hen is determined by the number of follicles destined for ovulation. In our study, treatment groups showed significant increase in the different follicular hierarchy. Similar result was reported in folliculogenesis and consequently in ovarian follicular development in laying hens (Ebeid *et al.* 2008). These authors reported that EP and NE injection to old laying hens (50-weeks-old) increased white, small and large yellow follicles.

Ebeid *et al*. (2008) reported that catecholamines, which are involved in stimulating progesterone secretion, are probably involved in the stimulation of the preovulatory release of GnRH and LH and consequently may be involved in the ovulation process. These authors mentioned that follicular catecholamines may play a regulatory role by altering follicular hemodynamics. Hormones might act on the ovary by controlling neural mechanisms affecting blood flow (Gilbert, 1969). Wolfenson *et al*. (1982) indicated that blood flow to the four largest follicles increased with increasing follicle size in laying hens. Therefore, catecholamines may affect the ovulatory process via regulating the follicular blood flow. Ebeid *et al*. (2008) mentioned that EP may play an important role in regulating ovulation via increasing plasma estradiol-17b concentration which in turn enhances ovarian follicular development by enhancing biosynthesis of hepatic yolk precursors.

CONCLUSION

The results of this experiment indicated that EP and BR injection increased egg production percent, shortened pause length and improved ovary folliculogenesis. Therefore, based on the results of this experiment, it could be concluded that EP and BR might have a part in promoting ovarian follicular development and consequently stimulating ovulation in old laying hens.

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