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Role of nitric oxide in ovarian follicular development and egg production in Japanese quail (*Coturnix coturnix japonica*)☆

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Abstract

Role of nitric oxide (NO) in regulating the reproductive functions at hypothalamo-hypophyseal-ovarian axis in Japanese quail was studied. In first experiment, metabolites of NO, i.e. nitrite and nitrate (NO_2 and NO_3) were estimated together in hypothalamus, serum and ovarian follicles of good and poor layers. In the second experiment, different NO modulators such as L-arginine (L-Arg), sodium nitroprusside (SNP) and N^G-nitro-L-arginine methyl ester, HCl (L-NAME) were administered to the birds. In the first experiment, significantly higher ($P < 0.01$) NO_2 and NO_3 levels in serum, hypothalamus and largest (F_1) ovarian follicles were observed in good layers as compared to poor layers. Higher ($P < 0.05$) NO_2 and NO_3 concentration was observed in F_1 follicles than smaller follicles (F_2) only in good layers. The NO_2 and NO_3 concentration was significantly reduced ($P < 0.05$) in post ovulatory follicles (POFs) in comparison to F_1 and F_2 follicles. In the second experiment, the serum NO_2 and NO_3 concentrations were higher ($P < 0.05$) in the SNP, lower ($P < 0.05$) in the L-NAME group and unchanged in the L-Arg treated group in comparison to control group. Compared to control, L-Arg and SNP increased ($P < 0.05$) the hypothalamic NO_2 and NO_3 concentration where as L-NAME reduced ($P < 0.05$) these levels. The NO_2 and NO_3 concentration

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was increased ($P < 0.05$) as the follicle size increased and it was significantly reduced ($P < 0.05$) in POFs. The higher ($P < 0.05$) follicular NO_2 and NO_3 concentration was observed in L-Arg group in comparison to control group. Egg production was also found to be higher ($P < 0.05$) in L-Arg group whereas it was not different ($P > 0.05$) in SNP and L-NAME treated groups. The yolk weight and yolk to albumin ratio was reduced ($P < 0.05$) in L-NAME group in comparison to control group. It may be concluded from the present study that NO plays a key role in regulating follicular development, ovulatory mechanisms and egg production in Japanese quail.

Keywords: Nitric oxide; Follicular development; Egg production; Quail

1. Introduction

Nitric oxide (NO) is an autocrine and paracrine cellular mediator, which influences many reproductive functions. It is a neurotransmitter in the central and peripheral nervous system [1] and is required for the maintenance of vascular tone [2]. This potent vasodilator is synthesized through the oxidation of L-arginine by NO synthase [3]. Its action is mediated through cyclic guanosine monophosphate by activating the enzyme guanylyl cyclase [4]. The NO synthesized in the ovary has been postulated to regulate follicular development, ovulation, luteal formation and steroidogenesis in rats and rabbits [5–10]. It is also involved in the control of pulsatile release of luteinizing hormone releasing hormone (LHRH) in mammalian species [11].

The role of NO in regulating female reproductive function in birds is yet to be established. In birds, the ovary is made up of a mass of about 480,000 small ova and of these 250–500 reach maturity [12]. Follicles develop under the influence of follicle stimulating hormone and attain a size of 2–4 cm in diameter before ovulation. There is a gradation in maturity of the ovarian follicles, which is called follicular hierarchy [13]. The existence of a NO system in the ovary of Japanese quail has been reported [14] but its involvement in controlling reproductive events in avian species is not known. Therefore, the present investigation was carried out to study the role of NO in regulating follicular development, maintenance of follicular hierarchy, ovulation and egg production in Japanese quail.

2. Materials and methods

2.1. Experimental birds

Japanese quail (*Coturnix coturnix Japonica*) chicks were obtained from the CARI, Izatnagar and reared under uniform husbandry conditions. The female birds were shifted to individual laying cages at sexual maturity and egg production of each bird was recorded.