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Spermatogenesis in the turkey (*Meleagris gallopavo*): Quantitative approach in immature and adult males subjected to various photoperiods

Jérôme Noirault [a], Jean-Pierre Brillard [a,*], Murray R. Bakst [b]

[a] *I.N.R.A., Station de Recherches Avicoles, Centre de Tours, 37380 Nouzilly, France*
[b] *Biotechnology and Germplasm Laboratory, ARS, USDA, Beltsville, MD 20705, USA*

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Abstract

The objectives of this study were to identify and quantitate the germ cell populations of the testes in sexually mature male turkeys (Trial 1), determine the duration of meiosis based on BrdU labeling and stereological analyses (Trial 2), and examine the impact of various photoperiods on germinal and somatic cell populations in immature and adult males (Trial 3). In Trial 1, both testes within a male had similar stereological components ($P > 0.05$) for all parameters analyzed. In Trial 2, the duration of Type-1 spermatocytes and round spermatids in turkeys lasted 4.5 ± 0.5 and 2.0 ± 0.5 days, respectively. In Trial 3, the short photoperiod (7L:17D) delayed testicular growth (in the stereological parameters analyzed). In contrast, the effect of a moderately short photoperiod (10.5L:13.5D) was comparable to the effect of a long (14L:10D) or increasing photoperiod (7L:17D to 14L:10D) on the stereological parameters examined. With the exception of the short photoperiod, all other photoperiods used in this study induced comparable early testicular maturation, with maximum testis

Abbreviations: El, elongated spermatids; Fwt, testes fragment weight; MR, meiotic ratio; Ø, seminiferous tubule diameter; θ, mean lifespan; nSert, Sertoli cell counts; nSpcI, primary spermatocyte counts; nSpdR, round spermatid counts; NSert, total number of Sertoli cells per testes; NSpcI, total number of Type-I spermatocytes per testes; NSpdR, total number of round spermatids per testes; Sert, Sertoli cells; SE, seminiferous epithelium; Spg, spermatogonia; Spc I, Type-I spermatocytes; SpcII, Type-II spermatocytes; SpdR, round spermatids; ST, seminiferous tubule; Tspz, testicular spermatozoa; TSP, testicular sperm production; V_r, relative volume

* Corresponding author. Tel.: +33 2 47 42 7645; fax: +33 2 47 42 7778.
E-mail address: brillard@tours.inra.fr (J.-P. Brillard).

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weight at 29–35 weeks of age. As the males got older, there was a progressive, linear decline in testis weight through 60 weeks, at which time there were no significant differences among photoperiods. In conclusion, the duration of meiosis in the turkey was similar to that observed in the fowl and guinea-fowl. The existence of a threshold of photosensitivity to gonad stimulation in male turkeys is suggested to be between 7.0 and 10.5 h of light.

Keywords: Photostimulation; Turkey; Poultry; Spermatogenesis; Semen production

1. Introduction

Quantitative studies on the impact of various photoperiods on the stereology and morphology of cells forming the seminiferous epithelium (SE) in domestic avian species are scarce; they are limited to works by Kumaran and Turner [1] and de Reviers [2] in fowl, Clulow and Jones [3] in Japanese quail, Marchand and Gomot [4] in ducks, and Brillard [5] in guinea-fowl. Cellular associations between specific stages of spermatogenesis have been described; they have facilitated quantitative studies of mammalian spermatogenesis [6,7]. In contrast, such associations in avian species, if they exist, have limited value to quantitate spermatogenesis, due to the existence of atypical stages [8–10]. The difficulty in describing such cellular associations in the avian SE is probably due to the relatively rapid transitions of certain germ cell categories [11]. Overall, the various stages of spermatogenesis in avian species appear to be of shorter duration than corresponding stages in mammals [12,13]. For example, while the time from the onset of meiosis to the end of spermiogenesis is about 26 days in the mouse [14], 29.5 days in the ram [15], 37 days in the bull [16], and 45.5 days in human [17], it is only 14 days in the fowl or drake [12,13], 11 days in the quail [18] and 14 days in guinea-fowl [19].

From a quantitative perspective, the efficiency of spermatogenesis is reflected in the number of spermatids derived from a single spermatocyte and on the ability of a given spermatid to transform into a functional spermatozoa. This efficiency is a strong indicator of the reproductive potential of an individual male [15,16,20]. In species with seasonal reproductive cycles (e.g. poultry), age and photoperiod influence the variation in testis weight and stereological characteristics of the germ cells in the SE of the fowl [21,22], turkey [23] and guinea-fowl [24,25].

The response of commercial poultry species to photoperiod is species specific. Male fowl raised under short-constant days (8L:18D) reached sexual maturity 3–4 weeks later than those subjected to a long-constant photoperiod (16L:8D) [21], whereas turkeys [23] or guinea-fowl males [24] subjected to comparable short-constant days (7L:17D) had sexual maturity delayed by 20–30 weeks. Subjecting male fowl [20], and guinea-fowl [25] to increasing photoperiods may, depending on the age at photostimulation, result in precocious and persistent testicular development over the reproductive season. The effect of increasing photoperiods on the onset of testicular development, germ cell populations and sperm output over the entire reproductive season in turkeys is not known. In the present study, three experiments were conducted to help elucidate the impact of age and