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Impact of male–male competition and morphological traits on mating strategies and reproductive success in broiler breeders

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Abstract

The goal of this experiment was to determine the effect of male–male competition on broiler breeder mating strategies and reproductive success and to identify behavioral and morphological traits associated with high fertility. Males were kept in groups with no competition (one male and 10 females; 1M), or high male–male competition (three males and 10 females; 3M). For each male we recorded the frequency of matings, forced matings, cloacal contacts and morphological traits (body weight, comb, wattle, tarsus and spur size), together with sperm quality and the reproductive success. Mating frequency consistently increased towards the end of the light phase. Significantly, higher mating activity occurred in 1M groups compared to 3M groups. Mating frequency of 1M males, however, did not differ from the frequencies of the males with the highest mating frequency in 3M groups. After reducing the number of males from 3M to 1M in the second experimental phase we found significant increase in the mating frequency. This probably was a consequence of the reduction in the level of male–male competition or due to female response to a lower number of males. DNA fingerprinting results indicated that the males with the highest mating frequency did not always sire the most offspring within the group. The males with the highest sperm mobility or largest ejaculate volumes were equally successful. Frequency of forced mating was not affected by the level of competition, but was more likely used by heavier males or those with larger combs and wattles. We did not find any of the studied morphological traits to be reliable indicators of male reproductive

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potential, although this lack of association may have been affected by relatively low number of males available for this study.

Keywords: Broiler breeder; Mating behavior; Competition; Paternity; Fertility

1. Introduction

Modern broiler strains reach 1500 g body weight in 33 days, compared to 120 days needed in 1925 (Albers, 1998). However, the genetic selection process required to achieve this high growth rate has an unwanted byproduct in the form of decreased fertility (Emmerson, 2000). The reasons for this fertility decline are probably multifactorial. Increased body size and muscularity of broiler breeder males may impair the ability to complete matings and successfully transfer sperm (Hocking and Duff, 1989; Duncan et al., 1990; McGary et al., 2002). Changes in mating behavior (Cheng et al., 1985), reduced frequency of courtship behavior (Millman et al., 2000), together with a higher frequency of forced matings (Millman and Duncan, 2000a), and a higher level of aggression among males (Millman and Duncan, 2000b) have all been described for strains of domestic fowl heavily selected for performance traits.

Besides mating behavior, male reproductive success in domestic and red jungle fowl also depends on other factors such as dominance status (Guhl and Warren, 1946; Cheng and Burns, 1988; Jones and Mench, 1991; Johnsen et al., 2001), intensity of courtship behavior (Leonard and Zanette, 1998), time of mating (Cheng and Burns, 1988), male mating interference (Kratzer and Craig, 1980), or level of sperm competition (Birkhead et al., 1999).

Male domestic fowl may interfere with the mating activity of other males (Kratzer and Craig, 1980). As the level of male–male competition increases, interference is also likely to increase, leading to higher number of uncompleted matings and reduced reproductive success. In addition, considering sperm competition and last male precedence theory (see Birkhead, 1998 for review), males in highly competitive environments are predicted to mate at higher frequencies to out-compete the sperm inseminated by the preceding male (Ball and Parker, 1998). Differential reproductive success due to sperm competition has already been reported in poultry (Birkhead et al., 1999; Donoghue et al., 2003). However, both studies were based on results of artificial insemination with pooled sperm and not natural matings.

Higher mating frequency of dominant males may also indirectly be linked to the size of secondary sexual characters and female preference. Red jungle fowl females were shown to prefer to mate with large-combed males (Zuk et al., 1995), to win aggressive encounters over males with small combs (Ligon et al., 1990) and to be dominant (Johnsen et al., 2001). Well-developed secondary sexual traits are considered in the sexual selection literature to be indicators of good health (Hamilton and Zuk, 1982), reproductive condition (Møller, 1994) and to correlate with fertility and testicular weight (McGary et al., 2002). Not only the size of secondary sexual characters, but also the degree of fluctuating asymmetry (FA) of bilaterally symmetrical traits may be indicative of male quality. Males affected by genetic and environmental stressors express more bilateral asymmetry (Møller, 1990). In poultry, fast growth rate (Møller et al., 1995) and environmental stressors (Møller et al.,