Journal of Animal and Veterinary Advances 4 (4): 427-429, 2005

Productive and Reproductive Parameters of Does as a Function of Sex of Siblings During Gestation

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Abstract: This study examined the influence of sex ratio during multiple pregnancies on some reproductive and reproductive parameters of adult goats under intensive conditions. Goats were grouped according to sex of fetuses of the litter: females (F,FF or FFF; n= 356) and females and males (FM, FFM or FMM; n=270). Birth weight (3.11 ± 0.04 vs 2.95 ± 0.06 kg), weight at 25 days of age (7.36 ± 0.16 vs 7.27 ± 0.25 kg) and average daily gain from 1 to 25 days of age (170 ± 6 vs 174 ± 9 g) were similar between does born with a female twin and does born co-twin to a male. No effects of sex of adjacent littermate were found on pregnancy rate (0.71 vs 0.72; 1855 total services), prolificacy (1.63 ± 0.02 vs 1.66 ± 0.03) and age at first kidding (700 ± 12 vs 721 ±18). These findings indicate that the coexistence of a female with one or two males during the gestation period do not alter the growth and some reproductive performance of adult does.

Key words: Reproduction, growth rate, sex ratio, multiple pregnancies, goats

Introduction

In some polytocous species of mammals, the position of the fetus relative to the sex of its neighbor in uterus is a factor which alters the development of the reproductive organs during the fetal life and the sexual behavior and the reproductive performance in adult animals. In mice, females positioned between two males exhibit lower reproductive capacity (Drickamer, 1996 and vom Saal and Bronson, 1978), delayed puberty (vom Saal *et al*., 1991) and greater aggressiveness (vom Saal, 1983), compared with females positioned between females in the uterus. Female swine are more likely to exhibit lower rates of successful breeding if they are born in a male-biased litter (Drickamer *et al*., 1997) and gilts from litters with a male-biased sex ratio attain puberty later than those from litters with smaller proportion of males (Lamberson *et al*., 1988). In sheep, sex ratio between during multiple pregnancies does not alter age and weight at puberty, postnatal ovarian development, ovulation rate an litter size, but embryonic mortality is increased by the presence of males during intra-uterine life (Avdi and Driancourt, 1997).

Moreover, rams born with a male twin have a greater chance to be classified as a high serving capacity than those born co-twin to a ewe (Fitzgerald *et al*., 1993). The effect of intrauterine environment on the reproductive and productive performance of does apparently has not been documented. Therefore, the objective of this study was to determine whether the sex of siblings in utero affects subsequent reproductive and productive parameters of does.

Materials and Methods

The study was conducted using data collected from a commercial goat farm in northern Mexico, during 1991 to 1996. Data are from five pure-bred groups of goats including Toggenburg, Granadino, Saanen, French Alpine and Nubian and a crossbred group including first cross Criollo x dairy breeds. Goats were housed in open pens with sheet-metal shades year-round and fed a ration based on alfalfa hay, sorghum grain and molasses. At each breeding period (from May to December), bucks within breed were placed with their assigned mating lots of does of the same breed. At kidding, kids were individually identified and weighed within 24 hrs of birth. Kids were allowed to nurse their dams for 3 days and then were artificially reared.

Breeding records included information on date of mating age at first kidding, occurrence of abortions and stillbirths, kiddings and number and sex of kids born. Productive traits studied were birth weight, weight at 25 d of age and average daily gain from birth to 25 d of age. Dependent variables were analyzed using ordinary least squares analysis of variance (SAS, 1988), with a general lineal model that included sex of the fetuses as independent variable. Sex of siblings was grouped into 6 classes: F, FF, FFF, FM, FFM and FMM. Preliminary analyses revealed no sex group effect on productive and reproductive traits, therefore, for the final analyses only two sex groups were considered: females (F, FF or FFF) and females combined with males (FM, FFM or FMM).

Results and Discussion

Least squares means for productive traits are presented in Table 1. Sex of siblings during gestation did not significantly affect birth weight, weight at 25 d of age and average daily gain during the first 25 d of life. Thus, these results do not support the hypothesis that the endocrine environment to which does gestated with one or two males are exposed in utero, influence their post-natal growth. Similar findings have been presented for other polytocous species. In swine, intrauterine position appears to have little influence birth weight and postnatal development (Rhode Parfet *et al*., 1990b), although Wise and Christenson (1992) have reported lighter weights for female fetuses positioned between two males than females surrounded by two females. Likewise, no difference in growth or development has been related to fetal position within the uterus in rats (Tobet *et al*., 1982; Richmond and Sachs, 1984) and mice (Kinsley *et al*., 1986). Influence of adjacent fetus of different sex on productive traits also has not been found in sheep (Avdi and Driancourt, 1997).

No effects of sex of adjacent littermates were found on pregnancy rate (Table 1). Similar findings have been presented for sheep (Avdi and Driancourt, 1997), but not for swine. In gilts, those animals born in a male-biased litter are more likely to exhibit lower rate of successful breeding (Drickamer *et al*., 1997). Also, Rohde Parfet *et al*., (1990a) have reported a reduction of 13% in pregnancy rate (not significant) for gilts surrounded by two males during gestation, compared to gilts gestated with adjacent females. Thus, this data indicate that, in goats, the testosterone secreted by males during the fetal life apparently did not increased the likelihood of reduced pregnancy

rate of females gestated with one or two males. In rodents it has been hypothesized that the interaction of fetal estradiol and testosterone is the cause of reproductive and behavioral deficiencies in females surrounded by fetuses of different sex during the fetal life (vom Saal, 1989); although in pigs fetal weight differences are related to immunological differences in fetuses, rather than hormonal effects (Wise and Christenson, 1992).

Table 1: Least squares means for growth features of does with or without adjacent males during gestation

Sex group	No. of does	L.S. Means	SEM
Birth weight (kg)[a]			
Females[b]	356	3.11	0.04
Females and males[c]	270	2.95	0.06
25-d weight (kg)[a]			
Females	345	7.36	0.16
Females and males	257	7.27	0.25
Average daily gain: d 1-25 (g)[a]			
Females 345	170	6	
Females and males	257	174	9

[a] No significant differences among sex groups (α= 0.05). [b]Females= F, FF or FFF. [c]Females and males= FM, FFM or FMM

Table 2: Least squares means for reproduction features in does with or without adjacent males during gestation.

Sex group	Number	L.S. Means	SEM
Pregnancy rate (%)[a]			
Females[b]	1282 services	71	1
Females and males[c]	573 services	72	2
Litter size[a]			
Females[b]	909	1.63	0.02
Females and males[c]	410	1.66	0.03
Stillbirths (%)[a]			
Females[b]	909	5	0.7
Females and males[c]	410	6	1.1
Abortions (%)[a]			
Females[b]	909	3	0.6
Females and males[c]	410	3	0.9
Age at first kidding (d)[a]			
Females[b]	345	700	12
Females and males[c]	265	721	18

[a] No significant differences among sex groups (α= 0.05). [b]Females= F, FF or FFF. [c]Females and males= FM, FFM or FMM

In this study the presence of males during intra-uterine life did not affect prolificacy (Table 1). Studies with rodents (vom Saal, 1981), sheep (Avdi and Driancourt, 1997) and swine (Lamberson *et al.,* 1988) did not reveal intrauterine position effects on number of offspring born. In contrast Edgerton and Cromwell (1986) reported that low sex-ratio sows had larger litters than high sex-ratio sows.

Interestingly, embryonic mortality is been found to be higher in lambs born as twin with a brother, than in lambs born as twin with a sister (Avdi and Driancourt, 1997). The similitude in prolificacy in the present study between does born with a male twin or those born single or co-twin to a female, seems to indicate that the gestation of does adjacent to a male is not a factor affecting embryo survival in goats. Sex of adjacent fetus did not significantly affect percentage of stillbirths and abortion. This suggests that the presence of at least one male in the litter did not disrupt the endocrine environment necessary to maintain gestation in the adult animal. It is worth mentioning that placentas associated with male fetus in swine produces more estrone at the middle of gestation than placentas associated with female fetus, although sex of the fetus does not affect placental progesterone release (Tarraf and Knight, 1995).

Results of the analysis of age at first kidding are presented in Table 2. The presence of at least one male in the litter had no discernible effect on this trait. Age at puberty in swine (Rohde Parfet *et al.,* 1990) and sheep (Avdi and Driancourt, 1997) and age of vaginal opening in rodents (vom Saal, 1981) are not affected in animals surrounded by fetuses of different sex during the fetal life.

Conclusions

Taken together, these data suggest that goats are not similar to rodents and swine in their response to uterine environments effects, because sex of siblings during gestation does not appear to affect the reproductive success and growth performance of adult does.

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