Plasma progesterone concentrations and fertility of indigenous Small East African goats, bred after treatment with cloprostenol

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Abstract

Twenty non-lactating, indigenous Small East African does and postpubertal doelings were injected 125 μg cloprostenol, PG (i.m.). Animals in oestrus were penned with males every night for 45 days. Jugular blood samples for P4 determination were collected immediately before the cloprostenol injection, 4 days later and twice a week for up to 80 days after the end of the mating season. Of the 19 animals with basal P4 concentration 4 days after PG-treatment, only 4 (20%) conceived within 14 days of the treatment. Starting from 4 days after PG-treatment, 1 (5%), 6 (30%) and 8 (40%) of the remaining 15 animals exhibited a short luteal phase, a luteal phase of normal duration or remained anoestrus for 22.2±2.2 days, respectively. The average interval from introduction of the buck to the fertile oestrus for the 19 animals that eventually became pregnant was 23.2±2.3 days (range 9–45). From conception to midgestation the mean plasma P4 concentration ranged from 2.6±1.2 to 10.8±2.4 ng/ml and between days 25 and 35 of pregnancy these values were higher (P < 0.05) in twin-than in singleton-carrying does.

It is concluded that for optimal fertility in does of the Small East African goats treated with cloprostenol, mating should be postponed until the first spontaneous oestrus following such treatment. © 2000 Published by Elsevier Science B.V. All rights reserved.

Keywords: Indigenous goats; Cloprostenol; Progesterone; Fertility

1. Introduction

The Small East African goat is an important source of food in the region (Mgasa and Arnbjerg, 1993; Wahome et al., 1994). Prostaglandin F2 alpha (PGF2α) and its analogs, when injected into cycling does, have been demonstrated to cause luteolysis and induce or synchronize oestrus (Shutt et al., 1976; Perera et al., 1978; Bosu et al., 1978; Ott et al., 1980). Such manipulation of the cycle, if accompanied by acceptable pregnancy rates, would be a useful tool in introducing a suitable schedule for fixed-time AI. This ability to control the time of breeding would shorten the mating season and allow control of the time of kidding as well as produce uniformity of age in a group of kids which would facilitate management. However, there is a lack of data on some specific aspects of goat reproduction when compared to the other domestic species. For example, there is little information on the fertility of tropical goats following PGF2α or PGF2α analog-induced oestrus.

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With various degrees of reliability, both physical and laboratory methods have been used for pregnancy diagnosis in the doe (Ishwar, 1995). Determination of progesterone concentration in body fluids has been used successfully for this purpose (Thorburn and Schneider, 1972; Fleming et al., 1990; Chauhan et al., 1991). As multiple births are a frequent phenomenon in goats, it is not only desirable to know whether mated animals are pregnant, but also to estimate the litter size well in advance.

The objectives of the present study were to determine the fertility of the Small East African goat following cloprostenol-induced oestrus and whether there is a difference in plasma P4 concentrations in single- and multiple fetus-carrying does.

2. Materials and methods

This field study was conducted between 3 March and 24 August, 1997 on a flock of goats belonging to the Department of Animal Science and Production, Sokoine University of Agriculture (SUA), Morogoro, Tanzania. Details of location and climate of the area have been described (Kanuya et al., 1997).

Twenty indigenous Small East African goats, comprising of 13 nonlactating does and 7 postpubertal doelings, with average body weight of 22.7±1.0 kg (range 16–31) and age of 61.1±11.3 months (range 9–129) were utilized for this study.

Prior to the beginning of the study, the females were always kept separate from the males. The animals grazed on natural pastures and shrubs from about 0800 hours to midday, when they were taken to a shaded area to rest and drink water. At about 1500 hours they were again taken out to continue grazing up to about 1800 hours. During the night the animals were confined in a pen as a group.

At the beginning of the study (=beginning of mating season) one Norwegian White Landrace breeding buck, aged 30 months and weighing 51 kg, was placed with the females at 1800 hours to allow overnight mating with oestrous animals. The buck was separated again every morning at about 0700 hours. This procedure was continued nightly for 45 days. The Norwegian White Landrace buck was used in order to increase the quantity of meat- and milk-producing ability of the resulting crossbred offsprings.

On the first day of the study, prior to introducing the buck, a blood sample was collected by jugular venipuncture using heparinized vacutainer tubes. Plasma was harvested (Baurnfeind and Holtz, 1991) and aliquots were stored at −20°C pending P4 analysis. Immediately after collection of the first blood sample, each animal was injected i.m. with 125 μg cloprostenol, a PGF2α analog (PG; Estrumat® vet, Pitman–Moore, Harefield, England) in order to induce luteolysis and ovulation. Another blood sample for P4 determination was collected 4 days after PG-treatment, when the animals were expected to be in oestrus (Ott et al., 1980). Thereafter, blood samples were collected every 3 or 4 days (Tuesdays and Fridays) and continued for 80 days after the end of mating season. Plasma P4 concentration was assayed using a commercial radioimmunoassay kit (Coat-A-Count, Diagnostic Products, LA, CA, USA). Intra- and inter-assay coefficients of variation were 8.4% and 12.1%, respectively. The sensitivity was 0.1 ng/ml. From the P4 concentration profile of each animal, ovulation and conception were presumed to have occurred when a basal concentration (P4 < 1.0 ng/ml) was followed by sustained high P4 concentration (>1.0 ng/ml) to the end of blood sampling.

The dates, litter sizes and birth weights of each kid were recorded. Comparison of two independent means was performed using Student’s t-test at 0.05 level of significance. All data are expressed as mean ± SEM.

3. Results

Twelve animals had high plasma P4 concentrations (>1.0 ng/ml) prior to PG-treatment and had basal P4 concentrations 4 days later. Of the remaining eight animals, seven had basal P4 concentrations (<1.0 ng/ml) both before and 4 days after PG-treatment, while one animal had a low P4 before PG-treatment, but elevated concentration 4 days later.

The numbers of animals that conceived at various intervals after PG-treatment (=first introduction of the buck) is set out in Table 1. Of the 19 animals with basal plasma P4 concentrations 4 days after PG-treatment, only four (20%) conceived within 14 days of the treatment. Among these four animals, three had low plasma P4 concentration immediately prior to
PG-treatment and only one had exhibited PG-induced luteolysis.

The remaining 15 animals, from among those that had basal P4 concentrations 4 days after PG-treatment, showed different patterns of plasma P4 profiles. One animal (5%), which had elevated P4 prior to PG-treatment, underwent a short luteal phase characterized by a brief rise in plasma P4 concentration that was followed by basal P4 concentration 11 days after the PG-induced luteolysis. In six (30%) animals the basal plasma P4 concentration 4 days after PG-treatment was followed by a luteal phase of normal duration. In these animals, the subsequent basal P4 concentration occurred after an average of 20.5 ± 0.5 days. Eight (40%) does, all of which had elevated P4 concentration prior to PG-treatment, were anoestrous as shown by persistent basal P4 concentrations for an average of 22.2 ± 2.2 days starting from 4 days after PG-treatment. According to the P4 profiles, 19 (95%) animals became pregnant and all kidded. One animal showed irregular cyclicity to the end of the study. The average interval from the introduction of the buck to fertile oestrus was 23.2 ± 2.3 (range 9–45) days. The mean (±SEM) plasma P4 concentrations from the assumed day of conception to midgestation is shown in Fig. 1. From about day 7 after conception, twin-carrying does generally exhibited a higher plasma P4 concentration than those carrying a single fetus, although this difference was only significant ($P < 0.05$) between days 25 and 35 of gestation.

Fourteen does kidded singletons and five (25%) delivered twins. The average gestation length was 146.6 ± 2.6 days (range 143–151) with no difference due to the number of fetuses. The interval between the first and last kidding in the group was 35 days. There was no difference between the average birth

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Table 1
Number of does of the Small East African goats that conceived at various intervals after PG-treatment

Fig. 1. Mean (±SEM) plasma P4 concentration from conception to midgestation in does which kidded singletons (Y2: $n = 14$) and those which kidded twins (Y1: $n = 5$). x-axis: days from conception; y-axis: plasma P4 concentration (ng/ml).
weight of twins (2.3 ± 0.3 kg) and singletons (2.3 ± 0.5 kg).

4. Discussion

Although the short oestrous cycles in cycling does have been reported (Chemineau, 1983), functional corpora lutea are usually present from approximately day 4 to day 16 of the 20 days oestrous cycle in the doe (Bretzlaff, 1995). This means that a low P4 concentration would be expected for about seven days of every cycle. It is therefore rather surprising that 40% of the does, all of which had elevated P4 concentration prior to PG-treatment, failed to form functional corpora lutea and remained anoestrous for over three weeks following PG-induced luteolysis. This is a higher proportion and a longer duration of anoestrous than reported by Ott et al. (1980) where only one doe out of 20 showed no increase in serum P4 concentration until day 11 after treatment with PGF$_{2\alpha}$.

The goats of this study showed lower fertility at the PG-induced oestrus than at the ensuing oestrus: only one doe conceived at that oestrus and that there was an average of 23.2 ± 2.3 days from introduction of the buck to conception. This finding agrees with the report by Bretzlaff (1995) who noted that goats inseminated at PG-induced heats have reduced conception rates by approximately 10% but disagrees with the finding of Ott et al. (1980) that induction of oestrus with PGF$_{2\alpha}$ had no detrimental effects on fertility and pregnancy rates in goats.

In the present study, pregnancy was accurately diagnosed from P4 profiles in all goats that kidded. The plasma P4 concentration values in does carrying single or twin fetuses are comparable to those reported for temperate (Thorburn and Schneider, 1972; Chemineau et al., 1982) and other tropical (Ezzo and Shalaby, 1990) breeds of goats.

The higher progesterone concentration in blood plasma of does carrying twins (Fig. 1) may be associated with different numbers of functional corpora lutea as previously suggested by Chemineau et al. (1982). It also suggests that plasma progesterone determination during the fourth to fifth week of gestation can be used to predict the number of fetus(es) in the Small East African does. However, Chauhan et al. (1991) reported a low accuracy for predicting multiple pregnancy in goats by use of serum progesterone concentration. On the other hand, successful prediction of litter size using progesterone assay in ewes at about 100 days of gestation has been reported (West, 1986; Schneider and Hallford, 1996).

5. Conclusion

Because of the high proportion (40%) of acyclic does among the Small East African goats immediately after cloprostenol induced luteolysis, we conclude that mating should be postponed until the first natural (spontaneous) oestrus following such treatment. Furthermore, determination of plasma P4 concentration between the fourth and fifth week of gestation can help to predict does that are pregnant with twin- (multiple) fetuses.

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References


