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# Effect of Different Estrus Synchronization Protocols on Some Reproductive Traits in Nubian Goats*

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**Abstract:** The effect of estrus synchronization protocol on the conception rates and actual kidding percentage together with litter size, birth weight, twinning rates, sex of kids and sex ratio in Nubian goats were investigated. Eighteen Nubian goats were divided into three equal groups. The animals in group one were treated with vaginal sponges (VSP) impregnated with 45 mg flurogestone acetate (FGA) for 18 days, followed by a single dose of 400 i.u. of pregnant mare serum gonadotrophin (PMSG) upon removal of the VSP. The second group was subjected to a double injects of 7.5 mg prostaglandin ($PGF_{2\alpha}$), given eleven days apart. For the third group, a vasectomies buck was suddenly introduced and kept with the goats for 15 days to initiate estrus. Intact bucks were used to detect heat and mate with goats in the three groups. Does treated with $PGF_{2\alpha}$ and those subjected to the buck effect showed significantly higher pregnancy rates (66.6%) than those treated with VSP+ PMSG. (33.3%). However, the protocols of synchronization had no effect on the kidding rates, litter size and birth weight. The type of birth comprised both singletons and twins, but none of the three groups

**Key words**: Nubian goats; estrus synchronization; reproductive traits

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witnessed triplet birth. The average litter size was 1.5, and the ratio of twins to singleton was 2:1 in the three groups. PMSG needed to induce ovulation may have an adverse effect on sperm transportation in does. More studies are needed to evaluate whether intrauterine insemination or double insemination, carried out 48 and 64 hours after cessation of treatments, could overcome this problem and improve the fertility in Nubian goats.

## INTRODUCTION

Estrus synchronization is an important tool for genetic improvement as well as for research purposes and marketing. It allows the production of animals with similar age groups (Chemineau *et al.* 1993) and is the basis for successful A.I. and embryo transfer programmes (Wildeus 1999). Several advantages have been recognized in having a number of females in estrus during a very short period of time, like permitting the manager to schedule livestock handling and breeding to fit into a work schedule with other required activities and the elimination of time-consuming job of estrus detection. Furthermore, the breeding season can be shortened and more females become pregnant during the first week of breeding. Animals can be divided into desired parturition groups so that intensive care may be provided for limited periods. Likewise, parturition season can be shifted to coincide better with the most favourable marketing patterns (Bearden and Fuquay 1984).

However, successful techniques of estrus synchronization must not only establish tight synchrony, but also provide an acceptable level of fertility upon using artificial insemination or natural mating. In general, following spontaneous estrus, goats have high reproductive rates with conception rate not being a problem.

The objective of the present study was to examine the effect of hormonal treatments and natural stimulation of ovulation (buck effect) on pregnancy rate, kidding rate, litter size and birth weight in Nubian goats.

## MATERIALS AND METHODS

### Experimental animals

Eighteen mature multiparous Sudanese Nubian goats, with an average age of six years and 28.5 kg average live body weight, were selected from a goat flock belonging to the Animal Production Research Center (APRC), Kuku, Sudan. Abdominal palpation was performed to confirm emptiness. Three mature intact Nubian bucks together with a vasectomized one were also selected from the APRC flock. Necessary treatments to get rid of external and internal parasites were applied.

### Housing

The 18 selected does were divided into three groups of six animals each that match in body weights and parity order. Each of the two first groups were housed in two pens (6 does each), while the third group was accommodated in three small pens with two goats in each pen. The bucks were kept in a separate pen at a distance from the females pens.

### Feeding programme

The experimental animals were kept under zero-grazing system, where forages were cut and carried to the pens. The forages consisted of *Medicago sativa* (alfalfa) and *Sorghum bicolor* (variety Abu Sabeen). Abu Sabaeen was offered daily, while alfalfa was offered once weekly and during the last two months of gestation, it was offered on daily basis. Moreover, a concentrate mix (2.700 kcal, ME/kg; 17% CP) composed of molasses, groundnut cake, wheat bran, limestone, urea and salt was offered at a rate of 1 kg/animal/day. Blocks of salt lick and drinking water were provided *ad libitum*.

### Estrus synchronization and mating with a male

The first group was treated with vaginal sponges (VSP) impregnated with 45 mg flurogestone acetate (FGA) for 18 days. Following the removal of the VSP, each female in the group received an injection of 400 i.u. of pregnant mare serum gonadotrophin (PMSG) intramusculary. The second group was injected with 7.5 mg/ml prostaglandin ($PGF_{2\alpha}$) on day 1 and

another dose 11 days later. In the third group, a vasectomized buck was introduced suddenly after complete isolation and kept continuously with the goats for 15 days (buck effect). An intact buck was used to detect heat and mate with the goats in the three groups.

**Milk progesterone analysis for pregnancy diagnosis**

Milk samples (10 ml each) were collected from each doe at 21 days after mating in vials containing sodium azide as a preservative. Milk fat was separated by centrifugation at 2500 rpm for 15 minutes. The sample was then refrigerated at 4ºC for 15 minutes to harden the fat layer. A glass rod was then used to pierce the fat layer and the skimmed milk was pipetted to storage vial and stored at -20ºC pending progesterone assay by RIA technique. The progesterone assay procedure was done according to the FAO/IAEA assay protocol Version 3.1 (IAEA 1999).

**Studied parameters**

The fertility indices, including conception rates (determined by progesterone concentrations) and kidding percentage in the three groups, were monitored by adopting Bowen (1988) method. Furthermore, the birth weights, twinning rates, sex of kids and sex ratio were also recorded.

**Statistical analysis**

The progesterone concentrations, litter size and birth weight, in the three experimental groups, were compared using one-way analysis of variance followed by Duncan's multiple range test as a *post hoc*. The pregnancies as well as the type of births (singleton or twining, male or female) were analyzed using chi-square test. The data were analyzed by a computer programme using the Statistical Analysis System (SAS), release 5.16 (SAS 1986).

## RESULTS AND DISCUSSION

Measurement of progesterone concentration 19-23 days post breeding in blood and milk is a method for diagnosing pregnancy with high accuracy (Thimonier *et al*. 1977; Holdsworth and Davis 1979; Jain *et al.* 1980; Thibier *et al* 1982). Progesterone concentration in milk in does generally

reflects plasma concentration. Milk progesterone concentration above 10 ng/ml 22 to 26 days after breeding was classified as positive pregnancy. The milk progesterone concentrations obtained in the present study are shown in Table 1. In both the buck effect and the $PGF_{2\alpha}$ groups, milk progesterone concentration from 4 out of the 6 does was above 10 ng/ml indicating pregnancies in 66.6% of the does. In the third group treated with VSP + PMSG, two out of six females (33.3%) were pregnant. This result is in line with the results of Corteel *et al*. (1988) who found a fertility rate of 63% after using 50 mg cloprostenol (a prostaglandin analogue).

Table 1. Progesterone concentration (ng/ml) in milk of Nubian goats subjected to different synchronization protocols

| Synchronization protocol | Progesterone conc. (ng/ml) Mean ± SD (n) | Pregnancy percentage (n) |
|---|---|---|
| Buck effect | 19.39 ± 12.9 (5) | 66.6 (4)[a] |
| $PGF_{2\alpha}$ | 22.87 ±16.22 (5) | 66.6 (4)[a] |
| VSP+PMSG | 7.55 ± 8.34 (5) | 33.3 (2)[b] |

Values in the same column with different superscripts are significantly different at $P \leq 0.05$, according to Duncan's multiple range test.

$PGF_{2\alpha}$ = prostaglandin $F_{2\alpha}$

VSP+PMSG = vaginal sponge impregnated with flurogestone acetate + pregnant mare serum gonadotrophin

(n) = number of observations

Prostaglandin-based estrus synchronization system controls the estrus cycle by terminating the luteal phase through regression of corpus luteum. The early corpus luteum, between 0-5 days after estrus, is insensitive to PGF2ά because of the insufficient receptor sites (Bearden and Fuquay 1984). It is only responsive to prostaglandin between day 4 and 14 of the estrus cycle (Randall 1986; Evans and Maxwell 1987). Because not all stages of the estrus cycle are similarly responsive to treatment, a double injection system 11 days apart is the most widely used approach in goats (Wildeus 1999). It was reported that estrus normally occurs in a high proportion of females within 2 to 3 days following the second injection (Evans and Maxwell 1987).

Despite the fact that PMSG is used to induce and synchronize ovulation at a higher rate (Langford *et al*. 1983; Eppleston *et al*. 1991), an adverse effect on sperm transportation has been observed for this hormone in ewes (Aitken *et al.* 1990) Therefore, the significantly reduced pregnancy rate in the PMSG treated does in this study could be attributed to impaired spermatozoa motility. According to Quinlivan and Robinson (1967; 1969), this problem can be overcome by a double insemination carried out 48 and 64 hours after cessation of the treatment. More studies are needed to evaluate whether intrauterine insemination could partially overcome this problem and improves the fertility in Nubian goats.

Some reproductive traits monitored in the three experimental groups are presented in Table 2. The type of birth in the three groups consisted of both singleton and twin births, but none of the groups gave triplet birth. The protocols of synchronization had no effect on the kidding rates, litter size and birth weight. The kidding rate is a measure of fertility in the animal and is sometimes referred to as prolificacy. It is defined as the number of kids per doe per year and is affected by several factors such as breed, age of the doe, nutrition, year and season of kidding, dams post-kidding weight and sire (Kudouda 1985).

The results in Table 3 indicate that there was no significant difference in birth weight between the different treatment groups. The birth weights of males (2.37, 2.75 and 2.25 kg) for the three treatment groups were close to that reported by Gubartalla (1998) in Nubian goats (2.3 kg). The result also shows that the mean birth weight of female kids was 2.25, 2.00 and 2.00 kg for the buck effect group, $PGF_{2\alpha}$ and VSP+PMSG, respectively, which is the same as that found by Gubartalla (1998) who reported a mean weight of 2.00 kg but is lower than that found by El Hag (1990) in local Sudanese goats. There is a strong positive correlation between birth weight and live body weight (Datta *et al*. 1963). The birth weight is an important index for selection and upgrading since it affects the time taken to reach maturity. Several studies have demonstrated that although twins and triplets have lower birth and weaning weights and slower growth rates, they produce more total weight of kid per doe per year.

Table 2. Some reproductive traits monitored in estrus-synchronized Nubian goats

| Trait | Treatment | | |
|---|---|---|---|
| | Buck effect (n = 6) | $PGF_{2\alpha}$ (n = 6) | VSP+ PMSG (n= 6) |
| Response/ pregnancy | 4 | 4 | 2 |
| Response (%) | 66.6 | 66.6 | 33.3 |
| No. of kids born | 6 | 6 | 3 |
| Kidding (%) | 150 | 150 | 150 |
| Litter size | 1.5 | 1.5 | 1.5 |
| Type of birth | | | |
| Singletons | 2 | 2 | 1 |
| Twins | 4 | 4 | 2 |
| Sex ratio | | | |
| Male : Female | 4:2 | 4:2 | 2:1 |

$PGF_{2\alpha}$ = prostaglandin $F_{2\alpha}$

VSP+PMSG = vaginal sponge impregnated with flurogestone acetate + pregnant mare serum gonadotrophin

Table 3. Kid's birth weight born to Nubian goats subjected to different synchronization protocols

| Syn. protocol | Birth weight (kg) | | | |
|---|---|---|---|---|
| | Males | Females | Twins | Singletons |
| Buck effect | 2.37 ± 0.23 | 2.25 ± 0.25 | 2.25 ± 0.25 | 2.50 |
| $PGF_{2\alpha}$ | 2.75 ± 0.25 | 2.00 | 2.25 ± 0.25 | 3.00 |
| VSP + PMSG | 2.25 ± 0.18 | 2.00 | 2.25 ± 0.25 | 2.00 |

$PGF_{2\alpha}$ = prostaglandin $F_{2\alpha}$
VSP+PMSG = vaginal sponge impregnated with Flurogestone acetate + pregnant mare serum gonadotrophin

## CONCLUSION

Estrus synchronization using $PGF_{2\alpha}$ and the buck effect methods reflected favorably on the reproductive traits tested in the Nubian goats. PMSG needed to induce ovulation may have an adverse effect on sperm transportation in does. More studies are needed to evaluate whether intrauterine insemination or double insemination, performed 48 and 64 hours after cessation of the treatment, could partially overcome this problem and improves the fertility in Nubian goats.

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# تأثير استخدام طرق مختلفه لمزامنة الشبق على بعض الصفات التناسليه للماعز النوبى

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**موجز البحث:** أجري هذا البحث لدراسة تأثر طرق مزامنة الشبق علي بعض الخصائص التناسليه مثل معدل الحمل و الولادات، بالإضافة إلي عدد المواليد والوزن عند الولادة ونسبة التوائم وجنس المولود فى الماعز النوبي. تم استعمال 18 معزة قسمت الى ثلاث مجموعات. المجموعة الأولى تمت معالجتها بواسطة الاسفنجات المشبعه بـ 45 ملجم من هرمون الفلوروجستون لمدة 18 يوما قبل حقنها بـ 400 وحده دوليه بالعضل من هرمون مصل دم الفرس الحامل عند ازالة الاسفنجات. حقنت المجموعه الثانيه بجرعتين من هرمون البروستاغلاندين $F_{2\alpha}$ فى اليوم الاول واليوم الثاني عشر بواقع 7.5 ملجم في كل جرعه. أما فى المجموعه الثالثه فقد ترك ذكر مقطوع الأسهرين مع الإناث لمدة 15 يوم بعد ان عزلت عنه عزلاً تاماً. استخدمت ذكور بالغة وسوية لاكتشاف الحيال و تلقيح الإناث في المجموعات الثلاث. اوضحت النتائج ان مجموعتى البروستاغلاندين وابقاء الذكر مع الاناث اعطت نسبا اعلى فى الحمل (66.6%) من المجموعة التى عولجت بالاسفنجات المهبلية. كما أظهرت الدراسة أن طرق توحيد الشبق ليست لها تاثير معنوي على معدل الولادات ولا على عدد المواليد ولا الوزن عند الولادة. كان متوسط عدد المواليد متساويا فى كل المجموعات، حيث بلغ 1.5 مولودا، ونسبة التوائم الى المواليد المفردة 1:2 فى المجموعات الثلاث. تدنى نسبة الحمل فى المجموعة

المعالجة بالاسفنجات المهبلية قد يكون بسبب التأثير السلبي لهرمون مصل دم الفرس الحامل علي حركة الحيامن داخل المهبل. لذلك هنالك حاجه لإجراء دراسات لمعرفة ما إذا كان استخدام التلقيح المباشر داخل الرحم او اعادة التلقيح مرتين بعد 48 ساعة و 64 ساعة من اذالة الاسفنجات سيحسن نسبة الحمل في الأغنام المعالجة بالاسفنجات المهبلية.