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Effect of Synchronization Protocols on Timing and Duration of Estrus in Nubian Goats*

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Abstract: Three protocols were conducted to evaluate estrus onset, duration and synchronization in 18 Nubian goats. The goats were divided into three groups according to the body weight, 6 animals in each group. The animals in group one were treated with vaginal sponges (VSP) impregnated with 45 mg flurogestone acetate (FGA) for 18 days. Following the removal of the VSP, a single dose of 400 i.u. of pregnant mare serum gonadotrophin (PMSG) was applied intramuscularly for each doe. The second group was injected with 7.5 mg/ml prostaglandin ($PGF_{2\alpha}$) on day 1 and day12. For the third group, a vasectomized buck was introduced for 15 days to initiate behavioural estrus after a complete isolation for four weeks. These experiments were repeated using the same animals. The results indicated that all protocols (buck effect, $PGF_{2\alpha}$ and VSP+PMSG) synchronized estrus in Nubian goats with 100% response. However, the hormonal methods produced more compact synchronization of estrus than the buck effect. Therefore, the hormonal methods are more desirable for estrus synchronization, especially in fixed-time artificial insemination programmes. The mean duration of estrus in the buck effect

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group (42 hours) was significantly shorter than those in the $PGF_{2\alpha}$ (48 hours) and VSP+PMSG (60 hours) groups. The use of male effect for estrus synchronization could be of value as it is less expensive, available and practically field applicable

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Key words: Nubian goats; estrus duration; synchronization protocols; buck effect

INTRODUCTION

Artificial control of the estrus cycle has been an efficient means of increasing the reproductive capacity of goats by obviating the need for frequent visual inspection. Assisted reproductive technologies (ART) in the goat requires a reliable method for estrus control of female, and such a method is also essential in artificial insemination or embryo transfer programmes. The possibility of inducing estrus and ovulation in acyclic females and of synchronizing estrus and ovulation in groups of females offers an opportunity to increase the efficiency of goat production and to make artificial insemination more convenient, in herds or animals where heat detection is difficult. Additional advantages are the simplification of kid rearing and the control of diseases (Smith 1992).

Estrus synchronization can be achieved by different protocols; one of the simplest means of synchronization is the sudden introduction of a buck or its odour, and it has been shown that many does will come into estrus approximately 8 to 10 days later (Moore and Hall 1991; Smith 1992). The immediate contact resulting in a greater response than fence-line contact. Olfactory responses seem to be important as evidenced by a depressed response of anosmic does (Chemineau *et al.* 1986). The responsible pheromones are androgen-dependent and are present in the buck hair but not in urine. The other protocols include using hormonal treatments such as insertion of sponges or controlled internal drug-releasing device (CIDR) containing progesterone or its analogues for 16-18 days, with an injection of gonadotropin at or before its removal (Dhindsa *et al.* 1971; Evans and Maxwell 1987; Ahmed *et al.* 1998).

For estrus synchronization in cyclic females, two injections of prostaglandin $F_{2\alpha}$ 12 days apart will provide good synchronization. The pharmacological methods are effective in closely synchronizing estrus in the majority of females in the flock or herd, and predetermined fixed-time insemination can be practiced, but they do incur some expense in the purchase and administration of the pharmacological products. The natural method may be less expensive, but does not result in close synchronization of estrus (Evans and Maxwell 1987).

The objective of the present study was to assess the response of Nubian goats to hormonal protocols applied to induce estrus and to compare the efficiency of hormonal and natural (buck effect) methods for estrus synchronization.

MATERIALS AND METHODS

Experimental animals

Eighteen mature multiparous Sudanese Nubian goats were chosen from a goat flock belonging to the Animal Production Research Center (APRC), Kuku, Khartoum North. The chosen does were of six years average age (range of 5-7 years) and 28.5 kg average live body weight (range 26-35 kg). Abdominal palpation was performed to ensure that all animals were empty at the start of the experiment. Necessary treatments to get rid of external and internal parasites were applied. Three mature intact Nubian bucks together with a vasectomized one (operated four weeks before commence of the experiment) were also selected from the APRC flock.

Housing

The 18 chosen does were divided into three groups of six animals each that match in body weight and differ in age and parity. All animals in the first group were accommodated in one large pen. Likewise, all animals in the second group were also accommodated together in one pen. The animals in the third group were 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 comprised *Medicago sativa* (alfalfa) and *Sorghum bicolor* (variety Abu Sabeen). Abu Sabeen was offered daily, while alfalfa was offered once weekly. Moreover, a concentrate mixture (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. Salt lick blocks and drinking water were available continuously.

Synchronization protocol and experimental procedures

Two hormonal protocols were chosen to assess their effectiveness in synchronizing estrus in two groups of experimental animals. The first group was treated with vaginal sponge (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.e. of pregnant mare serum gonadotrophin (PMSG) intramuscularly. The second group was injected with two doses of $PGF_{2\alpha}$, given on day 1 and day 12. Each dose contained 7.5 mg $PGF_{2\alpha}$/ml. The time of initiation of behavioural estrus was then monitored and recorded by a teaser buck. For the third group, a vasectomized buck was introduced suddenly, after a complete isolation for four weeks, and remained with the females for consecutive 15 days to synchronize estrus (buck effect). Signs of estrus were monitored and recorded. These experiments were repeated using the same animals. During this phase of experimentation, data pertinent to time of onset of estrus, behavioural signs and estrus duration were recorded for each group.

Statistical analysis

The collected data pertinent to the timing and duration of estrus were compared between the three synchronization protocols using one-way

analysis of variance followed by Duncan's multiple range test as a *post hoc*. The data were analyzed by computer programme using the Statistical Analysis System (SAS), release 5.16 (SAS 1986).

RESULTS

Effect of synchronization method on the onset of estrus

The effects of the three treatments (buck effect, $PGF_{2\alpha}$ and VSP +PMSG) on onset of estrus are shown in Table 1. The number of responding does during 24, 48, 72, 96, 120, 144 and 240 hours for each group was monitored and recorded. The data indicated that within the first 24 hours, following the treatment, only one doe in the buck effect treatment showed estrus while 7 out of the 12 treated females in the VSP + PMSG group (58.3%) exhibited estrus and none of the females in the $PGF_{2\alpha}$ group demonstrated heat. During the next 48 hours, 4 more does in the buck effect group and 3 does in the VSP+ PMSG group demonstrated behavioural estrus while still none of the second group showed heat. In the third day after treatment (72 hours), 11 out of the 12 prostaglandin ($PGF_{2\alpha}$) treated group (91.6%) showed estrus, thus securing the highest synchrony of estrus in these treatments.

Within the first four days of experimentation, the hormonal treated group ($PGF_{2\alpha}$ and VSP + PMSG) showed estrus at 100% level, while only 66.6% of the buck effect group responded by exhibiting estrus. The beginning of estrus in this group was distributed within a longer duration, whereby two does, one doe and another one doe showed estrus during the 5^{th}, 6^{th} and 10^{th} day of experimentation, respectively, thus indicating slower rates of induction and synchrony of estrus compared to the hormonal protocols.

Estrus behaviour

Most of the heat signs reported in the literature were evident in the experimental animals e.g., restlessness, swollen external genitalia, mucus discharge from vulva, mounting of other goats and allowing mounting by others, wagging of the tail rhythmically from side to side, lack of interest in feeding and drop in milk production in some lactating does. Frequent urination after sniffing by the buck was also observed.

Table 1. Effect of different synchronization protocols on the timing of estrus onset in Nubian goats

Method of synchronization	Percentage (n) of estrus manifestation time (hour)						
	24	48	72	96	120	144	240
VPS + PMSG	58.3 (7)	25 (3)	0	16.66 (2)	0	0	0
$PGF_{2\alpha}$	0	0	91.66 (11)	8.33 (1)	0	0	0
Buck effect	8.33 (1)	33.3 (4)	16.66(2)	8.33(1)	16.66(2)	8.33(1)	8.33(1)

VPS + PMSG = Vaginal sponge + pregnant mare serum gonadotrophin
$PGF_{2\alpha}$ = Prostaglandin $F_{2\alpha}$
(n) = Number of observations

Effect of synchronization method on duration of estrus

The duration of the exhibited heat in the different experimental groups is shown in Table 2. The data revealed that estrus duration ranged from 24 to 96 hours in the three treated groups. Ten out of the 12 goats (83.3%) in the buck effect group showed estrus duration ranging between 24 and 48 hours, while the other two goats in this group exhibited estrus for 72 hours (16.6%). In the $PGF_{2\alpha}$ treated group also 10 out of the 12 goats manifested estrus for a duration ranging between 24 and 48 hours, while the other two females each showed estrus duration of 72 and 96 hours. In the third group (VSP + PMSG), only five does exhibited estrus for 24 and 48 hours, six does with 72 hours estrus duration and only one goat remained in estrus for 96 hours. The mean duration of estrus in the goats subjected to the buck effect, $PGF_{2\alpha}$ and VSP + PMSG were 42, 48 and 60 hours, respectively.

Table 2. Effect of different synchronization protocols on the estrus duration in Nubian goats

Estrus duration (hour)	Type of estrus synchronization protocol		
	Buck effect	$PGF_{2\alpha}$	VPS + PMSG
24	41.66% (5)	25% (3)	16.66% (2)
48	41.66% (5)	58.3% (7)	25% (3)
72	16.66% (2)	8.3% (1)	50% (6)
96	0	8.3% (1)	8.3% (1)
Mean	42.00 ± 18.09^{a}	48.00 ± 20.47^{b}	60.00 ± 21.71^{b}

Means with different superscript in the same row are significantly different at $P \leq 0.05$.

Number of observations is shown between brackets

DISCUSSION

The results obtained in this study showed that estrus in goats can be effectively induced and synchronized by using different hormonal protocols, which is in agreement with what has been previously reported (Langford *et al*. 1983; Romano 1996; Leboeuf *et al*. 2000).The result of estrus synchronization with VSP+PMSG at 100% level is in line with that found by Corteel (1975). Bongso *et al*. (1982) and Moore *et al*. (1989) reported responding values of 91%, 98% and 100% following the use of melengesterol acetate (MAP), progesterone (CIDR) for 9 days or FGA, respectively. The result also agrees with the finding of Smith (1992) who reported that the goats were in heat 12 to 36 hours after sponge removal. The present findings showed that 91.66% of the treated animals exhibited estrus within 72 hours after the second dose of $PGF_{2\alpha}$which is comparable to the result reported by Evans and Maxwell (1987) and Randall *et al*. (1980) who found that 97% of the females were in estrus within an average of 50 hours after the second dose of $PGF_{2\alpha}$.

Exposure to males after a period of isolation has been used for induction and synchronization of estrus (Whitley and Jackson 2004). The present result show that 100% response, due to the buck effect, was witnessed within 10 days of coexistence of the buck with the does (Table 1). This is in line with what was reported by Bearden and Fuquay (1984), Chemineau (1986) and Fletcher *et al*. (2002). The beginning of estrus in this group was distributed within a longer duration, whereby 16.6%, 8.3% and another 8.3% of the does showed estrus during the 5^{th}, 6^{th} and 10^{th} day of experimentation, respectively; thus, indicating slower rates of induction and synchrony of estrus compared to the hormonal protocols. Moreover, this natural method of estrus synchronization (buck effect) has proved to be effective only at certain times of the year, usually just before the onset of a natural breeding season, when the majority of females are not yet cycling (Evans and Maxwell 1987). It is not effective when females are already cycling, nor in the deep anoestrous period of the more seasonal breeds of goats (Evans and Maxwell 1987).

The mean estrus duration resulting from the two hormonally treated groups ($PGF_{2\alpha}$ and VSP + PMSG) was 48 hours and 60 hours, respectively, which is close to that reported by Devendra and Burns (1970) and Evans and Maxwell (1987) who recorded estrus duration ranging between 16 and 50 hours. The shortest mean estrus duration recorded in this study for the buck effect group (42 hours) was similar to that reported by Hafez and Hafez (2000). The presence of male with a group of females shortens the duration of estrus, probably through the effect of mechanical action of penis against the vaginal fornix during natural service (Romano 1993). However, according to Chemineau *et al*. (1993) the short estrus duration due to the male effect may be associated with an immediate increase in the number and amplitude of LH pulses in the female due to the contact with males. This increase in the pituitary activity stimulates ovarian follicular growth and elicits an LH preovulatory surge (Chemineau 1986). Chemineau (1986) suggested that the male introduction probably evokes the increase in the pituitary activity by inhibiting the negative feed back action of estradiol or directly affects the hypothalamic neurons that control the secretion of LH, an effect that is enhanced by the response to estrogens.

CONCLUSION

The finding of this study indicated that the hormonal methods are more desirable for estrus synchronization, especially for fixed-time artificial insemination programmes. However, the use of male effect for estrus synchronization could be of value as it is less expensive, available and practically field applicable.

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REFERENCES

Ahmed, M.M.; Makawi, S.E. and Jubara, A.S. (1998). Synchronization of estrus in Nubian goats. *Small Ruminant Research* 30, 113-120.

Bearden,H.J. and Fuquay, J.W. (1984). *Applied Animal Reproduction.* . 2nd edition. Reston Publishing Co.Inc., Virginia, U.S.A.

Bongso, T. A.; Fatimah, I. and Dass, S. (1982). Synchronization of estrus of goats treated with progestogens–impregnated intravaginal sponges and PMSG and reproductive performance following natural mating or A.I. with frozen semen. *Animal Reproduction Science* 5, 111-116.

Chemineau. P. (1986). Sexual behavior and gonadal activity during the year in the tropical Creole meat goat. I. Female oestrus behavior and ovarian activity. *Reproduction Nutrition and Development* 26 (2A), 441-452.

Chemineau, P.; Levy, F. and Thimonier, J. (1986). Effect of anosmia on LH secretion, evaluation and estrus behaviour induced by males in the anovular Creole goats. *Animal Reproduction Science* 10, 125-132.

Chemineau, P.; Dareau, A.; Locatelli, A. and Maurice, F. (1993). Ram induced short luteal phases-effects of hysterectomy and cellular composition of the corpus luteum.*Reproduction Nutrition and Development* 33, 253- 261.

Corteel, J.M. (1975). The use of progestogen to control the estrus cycle of dairy goat. *Annals of Applied Biology, Animal Biochemistry and Biophysiology* 15, 352-363.

Devendra, C. and Burns, C. (1970). *Goat Reproduction in the Tropics*. CAB Farnham Royal Buck, England.

Dhindsa, D.S.; Hoversland, A.S. and Metcalfe, J. (1971). Reproductive performance in goats treated with progestagen impregnated sponges and gonadotropin. *Journal of Animal Science* 32, 301-305.

Evans, G. and Maxwell, W.M.C. (1987). *Salamons Artificial Insemination of Sheep and Goats*. 2nd edition. Butlerworth, Sydney, Australia.

Fletcher, C.M.; Jackson, D.J. and Whitely N.C. (2002). Use of 48 hour kid removal to decrease the post –partum breeding interval in meat does. *Journal of Animal Science* 80 (suppl. 1), 290 (Abstr).

Hafez, E.S. and Hafez. B. (2000). *Reproduction in Farm Animals*. 7th edition. Lippincott Wiliams and Wilkins, U.S.A.

Langford, G..A.; Marcus, G..J. and Batra, T.R. (1983). Seasonal effect of PMSG and number of insemination on fertility of progestagen treated sheep. *Journal of Animal Science* 57, 307-312.

Leboeuf, B.; Restall, B. and Salamon, S. (2000). Production and storage of goat semen for artificial insemination. *Animal Reproduction Science* 62, 113-141.

Moore, R.W. and Hall, D.R.H. (1991). Artificial insemination using the buck effect to partially synchronize Cashmere does *Proceeding of the New Zealand Society of Animal Production* 51, 143-146.

Moore, R.W.; Dow, B.W. and Staples, L.D. (1989). Artificial insemination of farmed feral goats with frozen thawed semen. *Proceeding of the New Zealand Society of Animal Production* 49, 171-173.

Randall, S.; Nelson, D.R. and Hixon, J.E. (1980). Peripheral serum progesterone and luteinizing hormone concentration of goats during synchronization of estrus and ovulation with $PGF_{2\alpha}$. *American Journal of Veterinary Research* 41, 14-32.

Romano J.E. (1993). Effect of service on estrus duration in dairy goats. *Theriogenology* 40, 77-84.

Romano, J.E. (1996). Comparison of fluorgestone and medroxyprogesterone intravaginal pessaries for estrus synchronization in dairy goats. *Small Ruminant Research* 22, 219-223.

SAS (1986). *User's Guide Statistical Analysis System*. 5th edition. SAS Institute Inc. Cary, North Carolina, U.S.A.

Smith. M.C. (1992). *Estrous Synchronization and Embryo Transfer*). 2nd edition. Cornell University, Ithaca, New York, U.S.A.

Whitely, N.C. and Jackson, D.J. (2004). An update on estrous synchronization in goats: A minor species. *Journal of Animal Science* 82, E 270 - 276.

تأثير استخدام طرق مختلفه لمزامنة الشبق على توقيت وطول فترة الشبق في الماعز النوبى

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ملخص البحث: اجريت ثلاث تجارب لتقييم حدوث الشبق و طول فترة الشبق وتزامنه فى 18 من الماعز النوبى. قسمت الماعز الى ثلاث مجموعات بناءاً على الوزن الحى بواقع 6 حيوانات فى كل مجموعة. عولجت المجموعة الاولى بواسطة الاسفنجات (VSP) المشبعه بـ 45 ملجم من هرمون الفلوروجستيرون (Flurogestone acetate, FGA) لمدة 18 يوما قبل حقنها بـ 400 وحده دوليه بالعضل من هرمون مصل دم الفرس الحامل (PMSG) بعد ازالة الاسفنجات . اما المجموعه الثانيه فقد حقنت بجرعتين من هرمون البروستاغلاندين ($PGF_{2\alpha}$) فى اليوم الاول واليوم الثانـي عشر بواقع 7.5 ملجم في كل جرعه. وفي المجموعه الثالثه تُرك ذكر مقطوع الأسهرين مع الاناث لمدة 15 يوما بعد ان عُزلت عنـه عزلا تاما لمدة اربعة اسابيع. كررت هذه التجربه مرتين باستخدام الحيوانات نفسها. اوضحت النتائج ان الطرق الثلاث المستخدمة قد احدثت الشبق بنسبة 100% و ادت الطرق الهرمونيه الى تزامن الشبق بدرجة أكثر تطابقاً من طـريقة ابقاء الذكر مـع الإناث. وبالتالي فالطرق الهرمونيه هـى الافضل لاحـداث

المزامنة خصوصا فى برامج التلقيح الاصطناعى. كما وجد ان متوسط

اطوال فترة الشبق قد بلغت 42 ساعة فى مجموعة ابقاء الذكر مع الإناث والتى تعتبر اقصر معنوياً من نظيراتها في مجموعتي البروستاغلاندين $F_{2\alpha}$ (48 ساعة) والاسفنجات المهبلية المشبعه بالفلوروجستيرون (60 ساعة). ومع ذلك فان استخدام الذكر لمزامنة الشبق قد يكون ذو قيمه وذلك لقلة تكلفته وسهولة تطبيقه فى الحقل.