

Echo Determination of Follicular Growth and Ovulation Time in Nubian Goats Subjected to Oestrus Synchronization

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Abstract—This study was conducted to determine the effects of hormonal synchronization on oestrous responses and to determine the diameter of follicles to reach ovulation and size of ovulated follicles using ultrasonography in Nubian goats in Sudan. Three protocols, progesterone impregnated sponges (A), progesterone + eCG (B) and progesterone + PGF2 α (C) were used. Oestrus responses, oestrous onset, duration of oestrus and ovulation time were determined. The results obtained indicated that Mucus discharge was observed in all does in group A and C, but it was observed in 75 % of the does in group B. Tail flagging and mount to other does were observed in 50% of does irrespective of the treatment. The standing to be mounted was observed in all does (100%) irrespective of the treatment. Oestrus onset between three groups (A, B and C) was found to be 33.50 ± 5.50 h, 41.12 ± 11.66 h and 32.75 ± 4.11 h, respectively, without significant difference between groups. There was no significant difference in duration of oestrus between groups. Mean values of graafian follicles diameters after 20 hours post removal (HPR), was significantly ($P < 0.05$) higher in group A (0.95 ± 0.17 cm) and group C (0.92 ± 0.12 cm) than group B (0.65 ± 0.17 cm). No significant differences, in graafian follicles diameters, between groups were found after 24, 28, 32, 36 and 40 h after removal. The mean Ovulation time from sponge removal (44 h) was not significantly different between groups. Using ultrasound machine to detect Graafian follicles development and ovulation time was found to be a useful tool.

Keywords—Goats; oestrous; ovulation; follicles; ultrasonography.

I. INTRODUCTION

The Nubian goats, together with other indigenous goats (Desert, Nilotic, Dwarf and Tagari) are the only really acknowledged goat in Sudan (Hassan and El Derani, 1990) and among the best dairy goats in Africa (Devendra and McLeory, 1982). The sexual activity varies between individuals and breeds of goats. In west African dwarf goats, oestrus ranges from 19 – 40 h in duration (Abu *et al.*, 2008). In many dairy and meat producing breeds, oestrus duration is 30 - 48 hours (Greyling and Van- Niekerk, 1990). In other breeds, such as Angora, (Riesenberg *et al.*, 2001), oestrus appears to be shorter ranging from 17 – 24 hours. The oestrus onset occurred 28 – 30 h after sponges removal in Desert goats (Ashwag and Mohamed, 2015), Boer goats (Lehloeny, *et al.*, 2005) and in hair goats (Karaca, 2010). Valentim *et al.*, (2006) reported 33.4 h in Serrana goats. The average ovulation rate in the doe is 1 – 3 Oocytes, but can vary from 1 – 5 depending upon the breeds and management conditions (Pineda, 2003).

II. MATERIALS AND METHODS

Area of study: This experiment was conducted at the Faculty of Veterinary Medicine, Al-Butana University, Tamboul, Sudan
Animals and oestrus synchronization: Twelve apparently healthy and cycling Nubian does weighing 18.50 – 22.50 Kg were used in this study. The animals were 1.3 – 2 years of age and had shown at least two oestrus cycles (19 – 21 days). Does were treated with Fluorogestone acetate 40 mg intravaginal sponge (Chronogest, Intervet, Boxmeer, Holland) for 12 days by introducing the sponge into the anterior portion of the

vagina using a sponge applicator. After sponge removal does divided randomly into three groups: group A (n= 4) received Fluorogestone Acetate (FGA), group B (n= 4) received intramuscular injection of Prostaglandin (PGF2 α) 150 μ g and group C (n= 4) received a single intramuscular injection of 500 I.U equine chorionic gonadotrophin (eCG-Intervet, Holland).

Oestrus detection: Observations for oestrous to detect the onset was carried out every 4 hours after sponge removal using a sexually experienced Nubian buck, introduced for a period of 10 minutes.

Signs of oestrous: Tail flagging sign is the sign when the tail of the does erected and a vigorous tail waving. Tail flagging sign was indicated as the first sign of oestrus. This situation was seen when the animal started to come to oestrus. Mounting is second sign and was indicated when the doe mounts other does. Third sign was standing to be mounted by other. The last sign was mucus discharge and reddened vulva. Oestrus response was calculated as the number of does that showed standing oestrus and subsequently mated, over the total number of does in each treatment group and expressed as a percentage.

Ultrasonographic (echo) Determination of Ovulation: A Probe with outer dimensions of 10 cm length, 3 cm height and 2 cm width was introduced into the rectum (Kaspar, 1988). The transrectal ultrasound examinations were performed every 4 h from (20 to 48 h) after removal of sponges, holding the animals in a standing position. An equipment, Aloka SSD 500_R (Aloka Co., Ltd, Tokyo, Japan), with a probe model UST-660-7.5 (Aloka Co., Ltd) was used. Sonograms were recorded using a digital video for retrospective image

computer analysis. Image Tool 3.00 software was used for follicle measurement as described by Simoes *et al.* (2005).

Ovulation time: Ovulation time was detected using Ultrasonography by disappearance of large Graafian follicles and formation of corpora lutei (CL).

Statistical analysis: Means \pm SD were computed for all parameters studied, oestrus response rates were expressed in percentages. Data of time to initiation of oestrus, oestrus duration and time of ovulation were analyzed using Statistical Package for Social Science (SPSS 16.0). It was used to compare means between treatment groups. Values of $P < 0.05$ were considered significant.

III. RESULTS

The sings of oestrus after hormonal treatments in Nubian goats were illustrated in table I. Mucus discharge was observed in all does in group A and C, but it was observed in 75 % of the does in group B. Tail flagging and mount to other does were observed in 50% of does irrespective of the treatment. The standing to be mounted was observed in all does (100%) irrespective of the treatment. Oestrus response was not significantly different between the groups A (100%), B (100%) and C (100%) respectively.

TABLE I. Sings of oestrus after hormonal treatments in Nubian goats.

Groups	Tail flagging (%)	Mount to other does (%)	Mucus discharge (%)	Standing to be mounted (%)
A	50	50	100	100
B	50	50	75	100
C	50	50	100	100

Group A: FGA only, Group B: FGA + PGF2 α , Group C: FGA + eCG

The effect of hormonal synchronization on oestrus onset and duration (h) in Nubian goats were shown in table II. There was no significant differences in oestrus onset between groups, although oestrus onset was shorter in group C (32.75 ± 4.11 h) and group A (33.50 ± 5.50 h) than group B (41.12 ± 11.66 h). There were no significant differences between treatment groups in the duration of the induced oestrus periods, although oestrus duration was shorter in group B (23.00 ± 4.69 h) than group A (26.25 ± 4.19 h) and group C (29.75 ± 5.18 h).

TABLE II. Effect of hormonal synchronization on oestrus onset and duration (h) in Nubian goats.

Parameters	A	B	C
Onset of oestrus (HPR)	33.50 ± 5.50^a	41.12 ± 11.66^a	32.75 ± 4.11^a
Duration of oestrus (h)	26.25 ± 4.19^a	23.00 ± 4.69^a	29.75 ± 5.18^a

Means in the same column bearing different superscripts differ significantly ($P < 0.05$)

HPR: Hours Post Removal, Group A: FGA only, Group B: FGA + PGF2 α , Group C: FGA + eCG

Diameter of follicles: Diameters of follicles after oestrus synchronization in Nubian goats were presented in table III and figures 1 - 2.

Mean value of graafian follicle diameter after 20 HPR, was significantly higher ($P < 0.05$) in group A (0.95 ± 0.17 cm) and group C (0.92 ± 0.12 cm) than group B (0.65 ± 0.17 cm). No significant differences between groups were found after 24, 28, 32, 36 and 40 h after removal. However, the diameter of follicles reached 1.45 cm in group A and C at 40 HPR and reached 1.40 cm in group B, with no significant different among groups.

TABLE III. Effect of hormonal synchronization on diameter of follicle (cm) in Nubian goats:

Groups	20 (HPR) mean \pm SD	24 (HPR) mean \pm SD	28 (HPR) mean \pm SD	32 (HPR) mean \pm SD	36 (HPR) mean \pm SD	40 (HPR) mean \pm SD
A	0.95 ± 0.17^a	0.97 ± 0.20^a	1.25 ± 0.05^a	1.35 ± 0.14^a	1.30 ± 0.14^a	1.45 ± 0.05^a
B	0.65 ± 0.17^b	0.95 ± 0.35^a	1.10 ± 0.18^a	1.20 ± 0.08^a	1.20 ± 0.08^a	1.40 ± 0.00^a
C	0.92 ± 0.12^a	0.90 ± 0.25^a	1.27 ± 0.95^a	1.30 ± 0.08^a	1.30 ± 0.81^a	1.45 ± 0.05^a

Means in the same column bearing different superscripts differ significantly ($P < 0.05$)

Group A: FGA only, Group B: FGA + PGF2 α and Group C: FGA + eCG

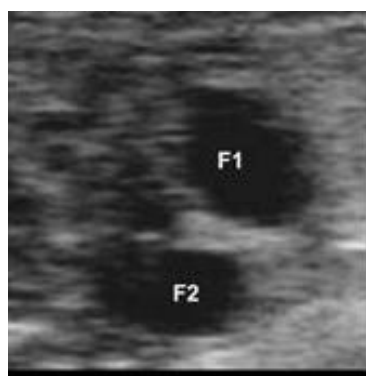


Fig. 1. Group (C): 36 HPR showing 2 mature follicles.



Fig. 2. Group (A): 40 HPR showing mature follicle.

Time of Ovulation: Time of ovulation after oestrus synchronization in Nubian goats is presented in table III. 50% of group A and C ovulated at 40 HPR, while all animals ovulated at 44 HPR.

TABLE IV. Percentage of does ovulated at different time after estrus synchronization in Nubian goats.

Groups	Ovulation checked time (HPR)		
	36	40	44
A	0%	50%	100%
B	0%	0%	100%
C	0%	50%	100%

HPR: Hours Post Removal, Group A: FGA only, Group B: FGA + PGF 2α , Group C: FGA + eCG

IV. DISCUSSION

The oestrus response was not significantly different between the groups A (100%), B (100%) and C (100%) respectively, this result is higher than (87%) reported by Fonseca et al. (2005) in Toggenburg goats, (20 %) obtained by Omontese et al. (2010) in prepartum Red Sokoto does treated with FGA alone and (73.5 %) reported by Greyling & Van der Nest (1990) using intravaginal MAP progestagen sponges. This variation may be due to effect of breed, location and climate (Mani et al., 1992; Romano, 2002; Evans et al., 2004). In the present study, does in group A and C exhibited oestrus earlier and mostly within the first (33 hours) after sponge withdrawal, while does in group B showed oestrus behavior much later than Group A and C. This result is shorter than which was reported by both Omontese (2012) in Sahel does treated with FGA for 15 days in combination with the intramuscular injection of 400 IU eCG concurrent with sponge withdrawal and Valentim et al. (2006) in nulliparous Serrana goats during anoestrus season, but higher than which was reported by Ashwag and Mohamed Nour (2015) in desert goats and Karaca et al. (2010) in hair goats. The time of oestrus onset in group A and group C is similar to 33.3 HPR reported by Nak et al. (2009) in lactating does synchronized with Ovsynch supplemented with progesterone.

The oestrus duration in the present study in group A (26.33 ± 5.14 h), group B (23.00 ± 4.69) and group C (29.75 ± 5.18) was shorter than (28 h) which was reported by Lehloeny et al., (2005) in Boer goats, Karaca et al., (2010) in hair goats and Elmubark, (2010) in the Desert goats. The result is shorter than (30.9 h) which was reported by Nak et al. (2009) in lactating does synchronized with Ovsynch supplemented with progesterone.

Follicles Diameter

In this study there was a significant difference ($P < 0.05$) in follicle diameter after 20 HPR between groups. It was significantly higher in group A (0.95 ± 0.17 cm) and group C (0.92 ± 0.12 cm) than group B (0.65 ± 0.17 cm). This results were less than (1.2 ± 0.14 cm) which was reported by Bartlenski et al. (1998), but higher than (0.70 cm and 0.72 cm) which was reported by Smith (1995) and Squires (2003)

for the Co-synch and Ovsynch does, respectively. The differences may be due to breed and location factors.

The diameter of follicle in this study at 24 HPR in group A (0.97 ± 0.20 cm) was higher than (0.83 cm and 0.81 cm) which was reported by (Smith, 1995; Squires, 2003) for the Co-synch and Ovsynch groups, and less than (3.4 ± 0.02 cm) which was reported by (Menchaca and Rubianis, 2002). The diameter of follicle in this study at 28 HPR in group B (1.10 ± 0.18 cm) was less than (3.5 ± 0.03 cm) which was reported by (Menchaca and Rubianis, 2002). The diameter of follicle in this study at 32 HPR in group C (1.30 ± 0.08 cm) was less than (4.1 ± 0.03 cm) which was reported by (Menchaca and Rubianis, 2002). The diameter of follicle in this study at 40 HPR in group A (1.45 ± 0.05 cm) was higher than (1.0 ± 0.25 cm) which was reported by Bartlenski et al., (1998) in anoestrus goat, and less than (4.2 ± 0.05 cm) which reported by Menchaca and Rubianis, (2002). The differences of follicle diameter between this study and other authors, may be due to variation in goat breeds and location of studies.

Time of ovulation: Ovulation is the rupture of the mature ovarian follicle on the surface of the ovary and the release of its contents, including the maturation Oocyte (Pineda, 2003). The ovulation time in this study (44 HPR) was higher than 32.5 ± 1.0 HPR in natural oestrus/nulliparous goats and 33.4 ± 1.5 HPR in induced oestrus/multiparous goats reported by Sanga et al., (2002), and shorter than 48 hours post sponge removal in Desert goats synchronized with Chronogest and 500 IU eCG (Ashwag, et al., 2015).

Time of oestrus onset to ovulation time in this study was (12 h) is similar to the result reported by Menchaca et al. (2002). The result is lower than (8.0 ± 1.6 h) which was reported by Baril and Vallet (1990) in superovulated goats. Goats are spontaneous ovulators and most goat breeds ovulate between 12–36 HPR (Jainudeen et al., 2000). The variation in ovulation time is possibly due to the effects of breed differences and seasonality in reproduction.

Ultrasound examination used in this study was found to be a useful diagnostic tool to estimate ovulation time in goats.

REFERENCES

- [1] A. H. Abu, F. C. Ihekumwure, and M. U. Onyekwere, "Effect of exogenous progesterone on oestrus response of West African Dwarf (WAD) goats," *African Journal of Biotechnology*, vol. 7, issue 1, pp. 59–62, 2008.
- [2] M. O. Akusu and G. N. Egbunike, Short Communication, Fertility of West African Dwarf goat in its native environment following prostaglandin F 2α induced estrus, *Vet. Q.* 6, pp. 173–176, 1984.
- [3] E. M. Ashwag, M. S. M. Nour, and M. A. H. Ghurashi, "Chronological relationships between oestrus onset, time of LH surge and ovulation time in does synchronized using fluorogestone with different doses of eCG," *Res. Opin. Anim. Vet. Sci.*, 5(4), pp. 183–188, 2015.
- [4] E. M. Ashwag and M. S. M. Nour, "Chronological relationships between estrus onset, time of LH surge and ovulation time in does synchronized with chronogest or CIDR," *International Journal of Technical Research and Applications*, vol. 3, pp. 290–293, 2015.
- [5] P. M. Bartlenski, A. P. Beard, S. J. Cook, and N. C. Rawlings, "Ovarian follicular dynamics during anestrus in ewes," *J. Reprod. Fertil.*, vol. 113 pp. 275–285, 1998.
- [6] S. V. Baril and N. R. Vallet, Superovulation, synchronization and breeding of does. *Small Rumin. Res.*, vol. 5, pp. 65–72, 1999.

- [7] C. Devendra and G. B. McLeory, *Goats and Sheep Production in the Tropics*, Longman Singapore Publishers London, UK, pp. 26:37- 45, 1982.
- [8] A. C. O. Evans, P. Duffy, T. F. Crosby, P. A. R. Hawken, M. P. Boland, and A. P. Beard, "Effect of ram exposure at the end of progestagen treatment on estrus synchronization and fertility during the breeding season in ewes," *Anim, Reprod. Sci.*, 65, pp. 112–116, 2004.
- [9] A. A. Elmubark, "The effect of improve feeding, oestrous synchronization and artificial insemination on reproductive performance of desert goats," Ph.D Theses, University of Khartoum, 2010.
- [10] J. F. Fonseca, J. H. Bruschi, I. C. C. Santos, J. H. M. Viana, and A. C. M. Magalhaes, "Induction of estrus in non-lactating dairy goats with different estrous synchrony protocols," *Animal Reproduction Science*, 85: (1-2), pp 117–124, 2005.
- [11] J. P. C. Greyling and C. H. Van- Niekerk, *Ovulation in Boer goat doe. Small Ruminant Research*, 3, pp. 457–464, 1990.
- [12] C. Gonzalez-Stagnaro, J. Pelletier, Y. Cognie, A. Locatelli, G. Baril, and J.M. Corteel, "Descarga preovulatoria de LH y momento de ovulacion en cabras lecheras durante el celo natural inducido por via hormonal," *Xth International Congress of Animal Reproduction and Artificial Insemination*, 2, 10–12 Urbana- Champaign, USA, 1984.
- [13] E. S. E. Hafez, *Reproduction in Farm Animals (6th edition)*, Lea and Febiger, Philadelphia, USA, pp. 94 – 113, 1993.
- [14] N. I. Hassan and O. H. El Derani, *Goat resources in the Arab World 2*, Republic of Sudan, 1990.
- [15] M. R. Jainudeen, H. Wahid, and E. S. E. Hafez, *Sheep and Goats in: Reproduction in Farm Animals*, B. Hafez, and E.S.E. Hafez (Eds). Lippincott Williams and Wilkins, Philadelphia, USA, pp. 172–181, 2000.
- [16] A. M. Karaca, "Ovulation in black bengal nanny goats," *J. Repord. Fertil.*, 58, pp. 67–69, 2010.
- [17] B. Kaspar, Beitrag zur Sonographie in der gynäkologischen Diagnostik, insbesondere zur Feststellung der Gravidität bei Schaf und Ziege. Tagungsbericht «Krankheiten der kleinen Wiederkäuer» der DVG, Gießen, 1988.
- [18] K. C. Lehloanya, J. P. C. Greyling, and L. M. J. Schwalbach, "Reproductive performance of South African indigenous goats following oestrous synchronisation and AI," *Small Ruminants Research*, 57(2), pp. 115-120, 2005.
- [19] A. U. Mani, W. A. C. McKelvey, and E. D. Watson, "The effects of low level of feeding on response to synchronization to oestrus, ovulation rate and embryo loss in goats," *Theriogenology*, 38 (6), pp. 1013–1022, 1992.
- [20] A. Menchaca and E. Rubianes, "Relation between progesterone concentrations during the early luteal phase and follicular dynamics in goats," *Theriogenology*, 57, pp. 1411–1419, 2002.
- [21] Y. Nak, Z. Nur, D. Nak, H. Sağırkaya, B. Tuna, G. Şimşek, B. Ustuner, "A comparison of the effects on estrus synchronization and fertility of FGA containing vaginal sponge + PGF2α + ECG and a combination of Ovsynch with vaginal sponge in dairy goats during the breeding season," *V. Reproduction and Artificial Insemination Cong.*, Elazig, pp. 92–93, 2009.
- [22] B. O. Omontese, P. I. Rekwot, H. J. Makun, J. A. Obidi, J. S. Rwuaan, and N. P. Chiezey, "Evaluation of EAZI-BREEDTM CIDR and FGA-30 intravaginal sponges as synchronizing agents in Prepartum Red Sokoto does," *Journal of Veterinary Research*, 3 (3), pp. 64–69, 2010.
- [23] B. O. Omontese, "Oestrus synchronization in red sokoto and sahel does using progestagens and gonadotrophin," MSc. thesis, Department of Theriogenology and Production, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, 2012.
- [24] M. H. Pineda, *Female Reproductive system In: MC Donald's Veterinary Endocrinology and Reproduction*, M. H. Pineda, and M. P. Dooley (Eds) Iowa state University, Press, Ames, Iowa, USA, 2003.
- [25] S. Riesenber, S. Meinecke-Tillmann, B. Meinecke, "Ultrasonic survey of follicular development following superovulation with a single application of pFSH, eCG or hMG in goats," *Small Ruminant Research*, 40(1), pp. 83–93, 2001.
- [26] J. E. Romano, "Does in pro estrus-estrus hasten estrus onset in does synchronized during the breeding season," *App. Anim. Behav. Sci.*, 77, pp. 329–344, 2002.
- [27] J. Simoes, J. Potes, J. Azevedo, J.C. Almeida, P. Fontes, G. Baril, and R. Mascarenhas, "Morphometry of ovarian structures by transrectal ultrasonography in Serrana Goats," *Animal Reproduction Science*, 85, pp. 263–273, 2005.
- [28] M. W. Smith and J. S. Stevenson, "Fate of the dominant follicle, embryonal survival, and pregnancy rates in dairy cattle treated with PGF2α and progestins in the absence or presence of a functional corpus luteum," *J. Anim. Sci.*, 73, pp. 3743–3751, 1995.
- [29] E. J. Squires, *Applied Animal Endocrinology*, CABI Publishing, Cambridge, Massachusetts, pp. 154–191, 2003.
- [30] D. F. Teleb, M. K. Gabr, and K. M. Gaafar, "Manipulation of lactation and suckling on the resumption of postpartum reproductive activity in Damascus goats," *Small Ruminant Research*, 49 (2): 183 – 1 , 2003.
- [31] R. Valentim, J. Azevedo, J.C. Almeida, T. Correia, R. Mascarenhas, P. Fontes, and J. Simoes, "Ovulation and oestrus synchronization using fluorogestone acetate vaginal sponges in nulliparous Serrana goats," *Reproduction in Domestic Animals*, 41, pp. 375-390, 2006.