

Review Article**Synchronization of Ovulation and Estrus in Small Ruminants - A Review****Neha Purey^{1*}, M.K. Awasthi², Asit Jain³, R.P. Tiwari⁴ and Sachchidanand Sarkar⁵**¹Veterinary Assistant Surgeon, Chhattisgarh Government²Professor, Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh³Associate Professor, Department of Animal Genetics and Breeding, College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur (M.P)⁴Professor and Head, Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh⁵M.V.Sc. Scholar, Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh**Abstract**

The study was intended to review the recent developments and advances in synchronization of ovulation and estrus protocols in small ruminants with a view to improve reproduction and production value. Fertility and fecundity of small ruminants can be improved with controlled breeding programmes, which are targeted for synchronized ovulation in precise period of time. Synchronization of ovulation requires the manipulation of luteal and follicular phase of the estrous cycle. For synchronization of ovulation various protocols viz. OvSynch, NCSynch, SelectSynch, intravaginal devices like FPE, CIDR with eCG, etc. have been devised and successfully used. OvSynch protocol involves GnRH- PGF_{2α} - GnRH treatment. The first GnRH injection on day 0 triggers ovulation of large follicle and also helps for the initiation of new follicular wave. PGF_{2α} injection on day 7 is aimed to regress the natural and accessory corpus lutea present in the ovary and the ovulation is timed by the next GnRH injection. The controlled internal drug release (CIDR) device has been proved to be effective for estrus control in cyclic and non-cyclic ewes. The ewes are treated with CIDR (controlled internal drug release) intravaginal devices containing 0.3 g progesterone, inserted for a 12-day period. At CIDR withdrawal, ewes are treated with eCG. The best method for synchronization of ovulation is CIDR with eCG protocol in ewes. OvSynch synchronization scheme may be a useful alternative to the classical “progestagen sponge (CIDR) + eCG” synchronization treatment. The conception rate obtained from using various synchronization protocols ranges from 60 to 85%. It is concluded that the OvSynch plus sponge protocol was found to be the most effective for synchronization of ovulation in small ruminants.

Keywords: Intravaginal devices, NCSynch, OvSynch, SelectSynch, Synchronization.**Introduction**

Day to day human population is increasing and the requirement of protein is also increasing. The major livestock products like meat, milk, wool, and there by products are very essentials for the developing countries as compared to the developed countries (Riaz *et al.*, 2012). With this scenario, there has emerged an interest in the application of

reproductive biotechnologies in small ruminants, including the synchronization of estrus and ovulation then fixed time intrauterine insemination or natural service, is necessary for sustainable goat production, in order to maximize meat, milk and its byproducts production (Senthilkumar *et al.*, 2016). India acquires second and third largest population

of goats and sheep in the world, respectively. Goats are considered as poor man's ATM where M stands for milk or meat or manure or market or money and thus are suitable for earnings to the families of small-scale farmers (Pujar *et al.*, 2016). Adaptation to adverse climatic conditions, increased meat production and early slaughter age because goat have a wide adaptability for any adverse climate conditions, high fertility rate, high feed conversion efficiency, fast growth rate so gain early slaughter age, increased meat production, and require low investment management skills. Goats and ewes are reproductive seasonality polyestrous due to a photoperiod effect (Joao Simoes, 2016).

Goat is polyestrous because near the equator region is tropical thus shows annually estrous cycle but in temperate region goat is seasonally polyestrous. The estrous cycle comprises 2-4 follicular waves, 4 in goat and 3 in ewes. After emergence of wave usually 2 to 3 follicles are continue growing and acquire a diameter of 5 mm and remaining follicles enter atresia. Each follicular wave is preceded by a transient increase in FSH concentration during each wave some follicles are recruited, some are selected and some are become dominant. The largest follicles ovulates or regresses and a new follicular wave emerges. Eventually most follicle undergo atresia. Only dominant follicles recruited after the third wave of after luteolysis of the CL produced in previous cycle become eligible for ovulation. Double and triple ovulation are common in sheep and goat. Ovulation is controlled

by the anterior-pituitary and ovarian hormone. The first synchronization of ovulation (OvSynch) treatment was developed by Twagiramungu *et al.* (1992) for beef cattle. The ovulation synchronization treatment for dairy cattle was developed by Pursley *et al.* (1995). The first synchronization of ovulation (OvSynch) treatment for goat was evaluated by Robin *et al.* (1994) who used GnRH in conjunction with intravaginal sponge to induce ovulation. Synchronization of ovulation is the process by which the reproductive cycle of an animal is manipulated by the use of exogenous hormones and their analogues to induce ovulation at a precise point in time. Synchronization of ovulation requires the manipulation of luteal and follicular phase of the estrous cycle (Senthilkumar *et al.*, 2016). Different types of hormonal treatment are used for the control of follicular waves. There are several types of hormonal combinations used at different time intervals for estrus and ovulation synchronization (Joao Simoes, 2016). In cycling female's large numbers of follicles are present, at that time first GnRH injection was given that triggers ovulation and formation of an accessory CL and new follicular wave. PGF2 α cause luteal regression and the second GnRH injection trigger the ovulation (Farooqi *et al.*, 2021). Two times PGF2-alpha were given in appropriate interval for the synchronization of estrus. Progestogen/progesterone impregnated vaginal devices and progestogen subcutaneous implants followed by an injection of equine chorionic gonadotrophin were used.

Protocols for synchronization of ovulation

1. G-P-G / OvSynch protocol

- Administration of first injection of gonadotrophin-releasing hormone (GnRH) on day 0 causes an LH surge that ovulates or luteinizes most large follicles present in the ovaries (Farooqi et al., 2021; Holtz et al., 2008). A new follicular wave then begins 1 to 2 days later. First GnRH injection is followed by a PGF2 α injection seven days later, most animals will possess mature dominant follicle of similar size at CL regression, resulting in a more synchronous ovulation with second GnRH injection on day 9. Second GnRH injection induces ovulation of the dominant follicle recruited after the first GnRH injection. Animals are inseminated at 12-14 hours after the second GnRH injection. Additionally, the GnRH induced luteinization of dominant follicles will induce cyclicity in many anestrus animal. There are several variations of GnRH-PGF2 α based breeding programme used in small ruminants. Conception rate with AI is 58 – 70%. OvSynch protocol with natural service heat (estrus) detection is required. For natural service 1 buck is required per 6 females in one



Fig.1. NCSynch protocol

pen. Conception rate in natural service is higher (66 – 80 %) as compared to A.I. Method.

3. NCSynch protocol

NCSynch – TAI (PGF2 α -Gn RH- PGF2 α -GnRH) protocol is like OvSynch type but pre-synchronization with PGF2 α was used. Prostaglandin was given on day 1 as pre-synchronization treatment. On day 8, GnRH was administered to ovulate or luteinize the present dominant follicles. Seven days later, on day 15, a second dose of PGF2 α injection was administered to induce the luteolysis. Does were artificially inseminated after 72 h of the second dose of PGF2 α injection at which time a second injection of GnRH was administered to induce the LH surge and ovulation (Fig.1). Conception rate is about 68% (Bowdridge et al., 2013).



Fig.2. Select Synch protocol

4. Select Synch protocol

This protocol is similar to OvSynch protocol but 2nd GnRH is not given. In select synch protocol first GnRH was given on day 0 then after 7 days PGF2 α was given then go for natural mating (Fig. 2). This protocol reduces the cost of 2nd dose of GnRH injection and also save the time with this protocol the conception rate was 66.66% (Pujar et al., 2016).

5. Two PGF2 alpha protocols

Two PGF2 alpha injections were given in ewes at 11 days intervals. 85-90% conception rate was obtained (Habeeb and Anne Kutzler, 2021; Anggraeni et al., 2021).

6. Intravaginal devices

Progestogen/progesterone impregnated intravaginal device contain synthetic P4 (Norgestomate). It slowly releases progesterone. Plasma progesterone levels increases rapidly after insertion of intravaginal device, reach highest concentration on day 3 and then gradually decreases intravaginal device modulate the pituitary LH secretion, inducing negative feedback, modifying the hypothalamic GnRH activity, followed by a preovulatory LH surge after intravaginal device removal in order to support the development of follicles, including the preovulatory follicle(s). The intra vaginal devices mimic CL function and provides possibilities to control the preovulatory development and controlling either luteolysis and follicular development to obtain more precise synchronization of estrus and ovulation.

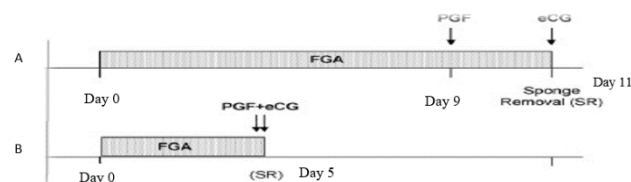
6.1 CIDR + eCG Protocol

CIDR is control internal drug release device which contain 9-12% of synthetic P4. This device is made up of silicon elastomer moulded over a nylon core. CIDR devices offer low natural dose of progesterone, induce earlier compact synchronization and do not absorb or obstruct drainage of vaginal secretions (Nogueira et al., 2011).

In this protocol the females were treated with intravaginal devices containing 0.3 g progesterone (CIDR), inserted for a 12-day period. At insert withdrawal, they were treated with eCG I/m. In anestrus goats, the eCG or a similar effect (such as male effect) is absolutely necessary for preovulatory follicles development. Then go for natural service or AI. AI is done after 50 hr of eCG injection. Conception rate is 85-90 % (Habeeb and Anne Kutzler, 2021). In another protocol CIDR was inserted for 9 days, post-insertion on day 7th PGF2-alpha was given then CIDR was removed and injection of PMSG was given. AI was performed after 24 or 48 hr and found with 28 or 42 % of pregnancy rate, respectively (Kim et al., 2021).

5.2 FPE Protocol

FPE protocol (fluorogestone acetate (FGA) – PGF2 α – eCG), in the long-term method the FGA is introduced for 11 days and PGF2 alfa is given on 9th day and at insert withdrawal on 11th day, ewes were treated with eCG injection (Fig.3.A). In short term protocol FGA is insert only for 5 days. At insert with drawl PGF2 α and eCG is given together (Fig.3.B). AI is performed after 48 hr. The fact that progesterone prevents the new corpus luteum formation and safeguards that 5day old or persistent CL are subjected to luteolysis by PGF2 α (Martemucci and Alessandro, 2011).



In short day protocol FGA is inserted for 9 days and PGF2 α given on the 7th day then eCG at sponge removal (Fig.3.C).

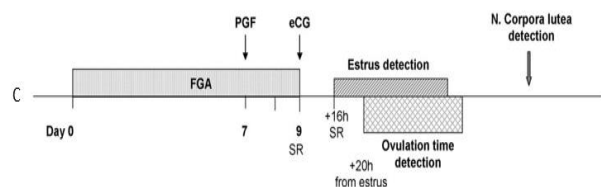


Fig. 3. FGA protocol A. 11 days, B. 5 days and C. 9 days

7. OvSynch with intravaginal device

The classical hormonal protocol is based on a seven-day intravaginal sponge with an I/m injection of GnRH on day 0 of synchronization of ovulation, PGF2 α at the time of sponge removal followed by second GnRH injection at 36-48 hr after the PGF2 α administered. Natural service or AI was done at 12-14 hr after the second GnRH injection for timed breeding (Senthilkumar et al., 2016).

Conclusions

Synchronization of the beginning of the follicular phase and of ovulation is successfully induced by the OvSynch treatment NCSynch-TAI is a novel, progestogen-free protocol that is successful in synchronizing ovulation for timed artificial insemination of goats. The use of eCG at device withdrawal induce adequate ovulatory follicular development and a very closely synchronized LH surge and ovulation leading to a better determination of time for FTAI. These new possibilities of ovulation synchronization programs

are attractive since they allow producers to supply meat and dairy products throughout the year.

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