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A REVIEW

Synchronization of estrous in dairy cattle in Rajasthan

RABINDRA KUMAR AND SUDEEP SOLANKI[1]

Members of the Research Forum
Associate Author :
[1]Veterinary University Training and Research Centre (RAJUVAS), SIROHI (RAJASTHAN) INDIA

AUTHOR FOR CORRESPONDENCE :
RABINDRA KUMAR
Veterinary University Training and Research Centre (RAJUVAS), SIROHI (RAJASTHAN) INDIA
Email: vutrcsirohi.rajuvas@gmail.com

Abstract : Estrus synchronization is a routine reproductive management tool for dairy producers. There are numbers of estrus synchronization programme available in dairy cattle using various hormones like progesterone, prostaglandin FGF2α and their various combinations with other hormones like estrogen and gonadotrophin releasing hormone (GnRH). Estrus synchronization can be completed with the prostaglandin PGF2α alone, but it requires the proper detection of the ovarian condition of the cattle as prostaglandin PGF2α is active in only functional corpus luteum in between 8 to 17 days of estrous cycle. The short time exposure of progesterone (less than 14 days) is useful for estrus synchronization. Progesterone or prostagland in based synchronization programme with addition of GnRH is helpful for better estrus synchronization. GnRH may be helpful to synchronize the estrous cycle in delayed pubertal heifers and post partum cows (*Post partum anoestrus*). Synchronization of estrus with GnRH-PGF2α protocol is preceded by progesterone treatment giving effective synchronization of estrus with high fertility rate.

Key words : Anoestrus, Estrus synchronization, Estrogen, Gonadotrophin hormone (GnRH), Prostaglandin (PGF2α), Progesterone

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INTRODUCTION

Estrus synchronization implies the manipulation of the estrous cycle or induction of estrus to bring a large number of a group of females into estrus at a short and predefined time (Odde, 1990). Synchronization of estrus is one of the advanced manage mental procedure by which the human faults and manage mental costs can be minimized. Estrus synchronization generally requires skilled management and adequate facilities. Historically, estrus synchronization is being promoted as a labour saving tool for those producers who want to capitalize on the superior genetics available through use of AI. Without synchronization, only one third of the cycling females can be expected to show estrus during the first week of the breeding season. Whether inseminated naturally or artificially, only 65 to 70 per cent can be expected to conceive to a given insemination. A successful estrous synchronization programme requires an understanding of the estrous cycle.

Reproduction is one of the most important aspects of a successful dairy operation, most dairy operations are focused on increasing milk production to increase benefits and reproduction directly impacts on milk production. Improved fertility and management of reproduction will increase milk production and overall farm profitability. Potential benefits from estrus synchronization in dairy cattle include reduced time devoted to estrus detection and reduced variability in days from parturition to first service, leading to reduced variability and length of calving intervals within a herd (Waldmann *et al.*, 2006). Poor heat detection rates and declining fertility are the primary factors contributing to the reduction in reproductive performance of dairy herds.

Pregnancy rate has developed as the best measure of herd reproductive performance and is the advent of new estrous synchronization programme. Combination of (GnRH) with the Prostaglandin PGF2aα (Pursley *et al.,* 1994 and Pursley *et al.,* 1995 a and b) and progesterone (Patterson *et al.,* 1999) based synchronization programme has shown a new way in the estrus synchronization of cattle with the manipulation of follicular development. The productivity of cattle could be low because of poor nutrition (Alam *et al.*, 2006) and incorrect detection of estrus (Roelofs *et al.*, 2010; Macmillan, 2010 and Paul *et al.*, 2011). Estrus synchronization provides more economic returns by improving the production efficiency in animals. Instead of females being bred over a 21-days period, synchronization can shorten the breeding period to less than five days, depending on the treatment regimen (Pursley *et al*., 2004). One of the major constrains of profitable dairy farming is low pregnancy rate in cows (Alam and Ghosh, 1994 and Shamsuddin *et al.,* 2001).This review discussed about the different hormones which can be used for estrus synchronization programme and their application in dairy heifer and cattle herds.

Basic approach for estrus synchronization:

Basic approach is to control the timing of the onset of estrus by controlling the length of the estrous cycle. There are the various approaches for controlling length of cycle.

– Administration of prostaglandin to regress the corpus luteum (CL) of the animal before the time of natural luteolysis or

– Administration of progesterone or more commonly synthetic progestin to temporarily suppress the ovarian activity or

– A newer way of creating estrous synchronization by using gonadotrophin-releasing hormone (GnRH) or analogue, this causes ovulation of a large follicle. This may help in synchronizing estrous cycle in anoestrous female.

Products used in estrus synchronization:

The common hormones to many protocols are progesterone, prostaglandin (PGF2α) and gonadotrophin-releasing hormone (GnRH). Which are available as commercial products listed in (Table1).

Estrus synchronization protocols:

The hormonal profile and functional structures present in the ovaries at different stages of estrous cycle are most important for the selection and successful implementation of the estrus synchronization programmed (Patterson *et al*., 2002). Administration of prostaglandin to regress the corpus luteum (CL) of the animal before the time of natural luteolysis or administration of progester one or more commonly synthetic progestin to temporarily suppress the ovarian activity, or a newer way of creating estrous synchronization is by using gonadotrophin-releasinghormone (GnRH) or its analogue, which causes ovulation of a large follicle (Ozill *et al*., 2011).

Table 1 : Commonly used hormones and their commercial products for estrus synchronization

Types of hormone	Origin	Function	Commercial name of products
Progesterone	Corpus luteum	Maintains pregnancy and suppresses ovulation	Controlled Internal Drug Release (CIDR), Melengesterol acetate (MGA)
Prostaglandin (PGF2α)	Uterus	Regresses the corpus luteum	Lutalyse, estrumate, synchsure, Prosta Mate
Gonadotrophin releasing hormone (GnRH)	Hypothalamus	Indirectly stimulates ovulation	Fertagyl, Cystorelin, Ova Cyst

Protocol based on prostaglandins approach:

Luteolysis consists of functional and structural regression of the corpus luteum (CL) (McCracken *et al.,* 1999 and Stocco *et al.,* 2007). Functional luteolysis is characterized by a decrease in secretion of progesterone (P4) in cattle (Ginther *et al.,* 2007). In heifers, the length of the luteolytic period is 24 hrs, based on hourly sampling (Ginther *et al.,* 2010a). During spontaneous and induced luteolysis, luteal size and blood flow decrease during functional luteolysis in cattle (Araujo *et al.,* 2009). Prostaglandin is a naturally occurring hormone. During the normal estrous cycle of a non-pregnant animal, Prostaglandin is released from the uterus 16 to 18 days after the animal was in heat. commercially available prostaglandins (Lutalyse, Estrumate and Prostamate) give the herd owner the ability to simultaneously remove the CL from all cycling animals at a predetermined time that is easy for estrus detection and breeding (Patterson *et al*., 2003). Luteolysis is temporally associated with an increase in Estrogen (E2) concentration (Ginther *et al.,* 2010b and Ginther *et al.,* 2011). Prostaglandin is the simplest methods for estrus synchronize in cattle instead of possessing major limitation, not effective on animals that do not possess a CL, animals within 6 to 7 days of a previous heat, prepubertal heifers and postpartum anestrous cattle. Estrus synchronization and fertility with prostaglandins is good for cyclic females such as virgin heifers, but cannot induce estrous cycles in non-cycling cows (Bader, 2003).

One shot prostaglandin :

A single injection of prostaglandin is given to cyclic females, and then these females are able to breeding when they express estrus. This programme may be modified first by detection of estrus in the cows of the herd for 5 days and inseminated the cows showing heat and only rest of the cows are given a single injection of prostaglandin. This shows the large savings of cost and labour associated with these treatments because only one injection is given and not need for all the cattle (Bader *et al.*, 2005).

Two shot prostaglandin :

Two injections of prostaglandins are given at an interval of 10 to 14 days once stage of estrous cycle in the cows is unknown. Detection of estrus is not need before or between injections. All cycling cows can respond to the second injection regardless of what stage of the estrous cycle they were in when the first injection was administered. The programme may be modified with the breeding of all females expressing heat subsequent to the first PGF2α injection. Then the second injection is given only to the females that were not bred.This results in two synchronized groups instead of one and longer breeding period (Sahatpure and Patil, 2008).

Protocol based on progesterone approach:

Synchronization of estrus with progestogens maintains high levels of progesterone in the female's system, even after the regression of the corpus luteum. Commercial products that comes under this protocol are melengesterol acetate (oral feeding), syncro-Mate-B (Ear Implant) and CIDR (Intra-vaginal device). Estrus synchronization was found 100 per cent when treatment began on day 9 of the estrous cycle. Generally, the longer the progestin was administered to cattle, the higher rate of estrous synchronization, but the lower the fertility of the synchronized animals (Moreira *et al*., 2000).

The low fertility of cows bred at the synchronized estrus following long-term administration of progestinis due to premature resumption of meiosis of ova or abnormal development of embryos derived from ova of persistent follicles. Cattle treated with progestogens for less than 14 days was reported not reduction in conception percentage. In addition, short-termexposure with progestogens treatment causes some anestrous (postpartum or pre pubertal) cattle to start cycling. However, for these short-term progestogens systems tobe effective in estrus synchronization, a luteolytic agentmust be incorporated (Revah and Butler, 2006).

Melengesterol acetate (MGA) feeding protocol :

– MGA was added to feed such that females received 0.5 mg per head per day for 14 days. After removal of MGA from the feed, cyclic females began to show estrus. The administration of MGA at the prescribed daily rate of

0.5 mg prevented the expression of behavioural heat, blocked the preovulatory LH surge and ovulation (Imwalle *et al*., 2002).

– An injection of prostaglandin was given 15-19 days after removal of MGA from the feed (Brown *et al*., 2008) developed a system in which MGA was fed for 14d. This system was designed to place cattle in the late luteal phase of the estrous cycle during the PGF2α administration. The rate of synchronization of estrus following MGA-PGF2α was found usually greater than that following the use of PGF2α alone (Patterson *et al*., 2002).

– Two injections of prostaglandin are given; one at the time of MGA removal from the feed and another 15 days following the removal of MGA.This further reduced the time spent in estrous detection and breeding (Patterson *et al*., 2002).

– MGA-GnRH-PGF2α protocol: MGA was administered to the cows orally for 14 days. Ten days after the with drawal of MGA an injection of GnRH was given. Seven days after the GnRH injection an injection of PGF2α was given. 80 per cent of the cows showed estrus within 48 to 96 hrs after PGF2α injection (Fonseca *et al*., 2004).

Protocol using synchromate-B (*SMB*) (*ear implant*) :

Treatment with SMB in the late estrous cycle (>day 14) in cow gives lower conception rates. The suitable time for SMB treatment to begin is between day 8 and day12 of the estrous cycle to maximize estrus response (Ravikumar and Asokan, 2008).

Controlled internal drug release (*CIDR*) *prototocol*:

Application of CIDR:

Controlled internal drug release (CIDR) is a T-shaped vaginal device used in livestock for the synchronization of estrus and made by molding a thin layer of silicon and progesterone mixture around a nylon spine under high temperature. The CIDR contains 1.38 g of progesterone and is designed to maintain elevated level of progesterone concentrations in blood at least 2ng/ml for upto 10 days. It is flexible nylon device attached to tail and allow for easy removal. The CIDR Inserted in Cattle provides an exogenous source of the hormone progesterone during the 7-day administration period. Removal of the CIDR Inserted in Cattle on treatment day 7 resulting in a rapid fall of plasma progesterone levels, which results in synchronization of estrus in those animals that responding to treatment (Moody and Lauderdale, 1997).

CIDR and PGF2α based protocol:

Intravaginal progesterone inserts (CIDR), coupled with PGF2α was approved for use in dairy heifers in the United States by the FDA (Eazi Breed®, Pfizer Pharmaceutical, New York Fig. 1) to control estrus behaviour in replacement heifers. It has been reported that the CIDR device is effective in estrus synchronization and increases pregnancy rates for the first 3 days of the AI period after CIDR removal (Lucy *et al.,* 2001)

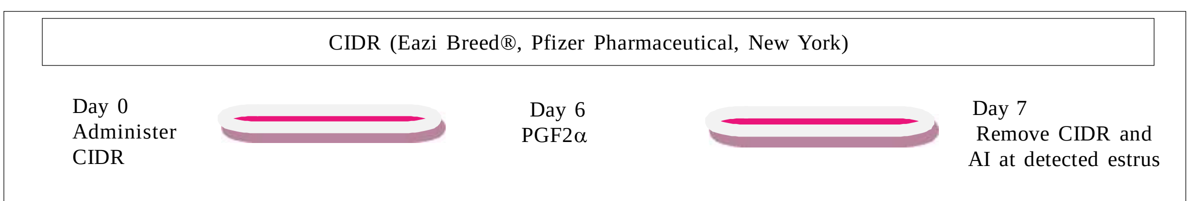


Fig. 1: Eazi Breed® protocol for heifers

The CIDR inserts are used for 7 days and PGF2α is administered 24 hrs prior to CIDR removal. In general, estrus occurs 2 to 5 days after removal of CIDR. If the PGF2α is administered at the time of CIDR removal, heat is delayed by 12 to 24 hrs and is more variable (Stevenson, 2005). With the use of CIDR various insemination options are available after removal; AI only based on detected estrus or AI those heifers detected in heat and timed AI of heifers not seen in heat at 60 to 66 hrs after PGF2α administration (Stevenson, 2005).

CIDR to GnRH based protocol:

Failure to appropriately synchronize cyclic animals or to induce a potentially fertile, ovulation in anestrous females can have major effects on the success of a synchronization protocol. The most common use of the CIDR to GnRH based system involves the insertion of the CIDR on day 1 and removal of CIDR on day 8. An injection of GnRH is given on day of CIDR insertion. The CIDR is put in position for seven days. On the day of CIDR removal, an injection of prostaglandin is given. The second GnRH injection is given after two days of prostaglandin injection.

The primary benefit of inclusion of the CIDR with GnRH based programme is that it guarantees that females will be exposed to progesterone during the period between days ranges 1 to 8 (Fonseca *et al*., 2004). A second benefit to inclusion of the CIDR with GnRH based programme is that the early heats (day 6 to 9) that are inherent to these systems and prevented. The progesterone released by the CIDR, will prevent estrus and ovulation between days 1 and 9 (Fonseca *et al*., 2004).

Gn-RH based estrus synchronization protocol:

Synchronization of estrus and fertility with a combination of GnRH and prostaglandin are good for cyclic females and this combination may enhance cyclicity in cows experiencing postpartum anoestrus (Pursley *et al.,* 1994 and Pursley *et al.,* 1995 a and b). Estrus synchronization by administration of GnRH during the bovine estrous cycle causes regression or ovulation following treatment (Pursley *et al*., 2005). Ovulation of a growing dominant follicle occurred 100 per cent of the time following GnRH administration however, ovulation of dominant follicles in the static or regressing phases occurred 33 per cent and 0 per cent of the time, respectively (Helmer and Britt, 2005).There are four systems of estrus synchronization with GnRH-PGF2α combinations *viz.,* Ovulation synchronization (Ovsynch), combination synchronization (co-synch), select synchronization (select synch) and hybrid synchronization (hybrid synch) (Patterson *et al.*, 2003).

GnRH–PGF2α system:

This combination represents the simplest GnRH–PGF2α based system. A common name for the GnRH-PGF2α system is "select synch".

Select-synch:

In select-synch, a single dose of GnRH and prostaglandin were injected on day 1 and day 7, respectively. Some of cows exhibit estrus upto 48 hrs before PGF2α (day 6). The early heats are fertile and cows can be inseminated 12 hrs after estrus detection. The peak estrous response occurs 2-3 days after administration of PGF2α between ranges of days 1–5. In this system, a minimum of 5 days of estrus detection after PGF2α and 2 days preceding PGF2α is required to detect most of estrus.

GnRH–PGF2~+GnRH system:

This is GnRH–PGF2α system that includes a second GnRH injection given to all or some of cows between 48 and 72 hrs after PGF2α (day 2 to 3), with timed AI on all or a portion of the herd. Several variations of this system are being used.

Ovsynch:

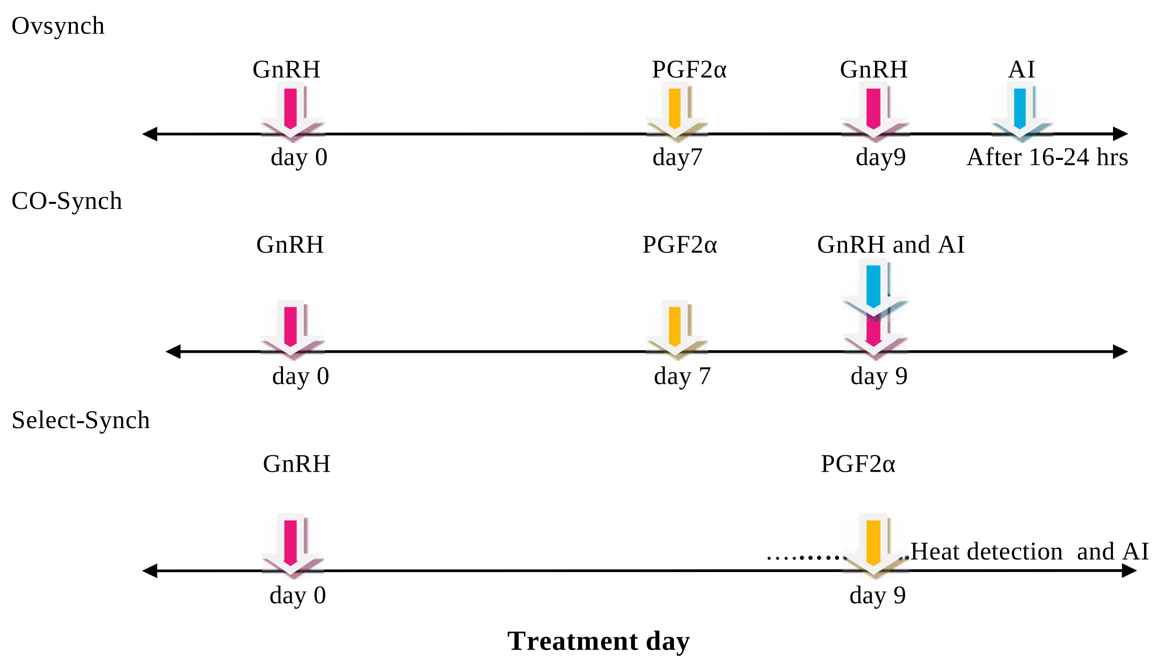
The Ovsynch programme is comprised of an injection of GnRH on day 1, an injection of prostaglandin on day 8, a second injection of GnRH on day 10 and then timed insemination on day 11 indicated that pregnancy rates varied when cows were timed inseminated at 0, 8, 16, 24 or 32 hrs after the second injection of GnRH in this Ovsynch protocol and the highest pregnancy rate (45%) was achieved when insemination was done 16 hrs after the second GnRH injection. The first GnRH injection alters follicular growth by inducing ovulation of the largest follicle (dominant follicle) in the ovaries after the GnRH injection and to form a new or additional CL. Thus, estrus usually does not occur until a PGF2α injection regresses the natural CL and the secondary CL (formed from the follicle induced to ovulate by the first GnRH injection) (Vasconcelos *et al*., 1999).

CO-synch:

The CO-Synch protocol is comprised of an injection of GnRH on day 1, an injection of prostaglandin on day 8 and then a second injection of GnRH with timed insemination on day10. The advantages are tight synchronization of estrus, most females respond to the programme and it enhances the estrus in non-cycling cows that are at least 30 days postpartum (Harrison *et al.*, 1990).

Hybrid-synch:

The hybrid-synch programme is implemented with an injection of GnRH on day 1, an injection of prostaglandin on day 8 and then estrous detection and insemination from day 8 to 10. If estrus not observed in females from day 8 to 10, then they are bred on day 11 with second injection of GnRH. This protocol hasa minimum cost and less handling as compared with ovsynch and CO-synch but more than select-synch. The primary advantage of hybrid-synch is having the highest conception rates among all GnRH–PGF2α protocol (Ravikumar and Asokan, 2008).



Methods were used to synchronize ovulation in postpartum cows: Ovsynch, CO-Synch and Select-Synch (Patterson *et al*., 2002).

Advantages of estrus synchronization:

Synchronization programme is to breed a large percentage of the females in a given group of heifers or cows in a short period of time, using either artificial insemination (A.I.) or natural service (bulls). Synchronization techniques resulting in a uniform animal crop and labor can be concentrated at parturition. Technologies for Estrous synchronization are very costly, laborious and generally produce lower rates of conception than natural service and other advantages of systematic breeding programmes are: to improve the efficiency of estrus detection, to achieve first service more timely, Reduction in the variation in calving intervals among cows by improving the pregnancy rate, possibly reduce involuntary culling for reproductive reasons, concentrate labour for reproductive management to specific time periods, Improvement in the overall reproductive performance of the herd and also used for silent heat or sub estrus heat and treatment of ovarian cyst (Cartmill *et al.*, 2001).

Conclusion:

Estrus synchronization is the most important nd widely applicable reproductive biotechnologies available for cattle. Improvements in facilities and management may be necessary before implementation of an estrous synchronization programme.Proper levels of nutrition, body condition and health are required for better Estrous synchronization programme.Estrus synchronization programme is done based on various hormones either natural or artificial like progesterone, prostaglandin (PGF2α) and gonadotrophin releasing hormone (GnRH) for deferent protocol methods. Generally there are significant benefits to genetic improvement and reproductive management that could be gained from the implementation of estrus synchronization.

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