SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)
ISSN (Print) 1813-1743, ISSN (online) 2791-0547
Vol. 54:3 (2022)
Doi: https://doi.org/10.26692/surj-ss.v54i3.4595

Applications to Control the Estrus Cycle in Bovines via Estrus Synchronization: A Review

ABDULLAH CHANNO[1]*, ABID ALI SANJRANI[2], MUHAMMAD BAKHSH[3], ASMATULLAH KAKA[1], AKEEL AHMED MEMON[1], QUDRATULLAH KALWAR[4], DILDAR HUSSAIN KALHORO[5], ABDUL SUBHAN[7], SHAKEEL AHMED TUNIO[6]
[1]Department of Animal Reproduction, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, 70060.
[2]Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, 70060
[3]Faculty of Veterinary Sciences, College of Veterinary and Animal Sciences, Jhang, 35200, UVAS Lahore, Pakistan.
[4]Department of Theriogenology, Faculty of Animal Sciences, Shaheed Benazir Bhutto University and Animal Sciences, Sakrand, 67210.
[5]Department of Veterinary Microbiology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, 70060
[6]Department of pathobiology, section Microbiology, Jhang, 35200, UVAS Lahore, Pakistan.
[7]Department of Livestock Management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, 70060.

Cite this:
Channo A, AA Sanjrani, M. Bakhsh, A. Kaka. AA Memon, Q. KAlwar, DH. Kalhoro, A. Subhan and SA. Tunio (2022). Application to control the estrus cycle in Bovines via estrus synchronization: A Review (2022). Sindh Uni. Res.J. (SS) 54:3 2022.

Corresponding author
channoabdullah47@gmail.com

Abstract

Estrus Synchronization is the main application of Assisted Reproductive Technologies (ART). It helps in the control of the estrus cycle with the basic help of Hormones and ads controlled Artificial Insemination, reduction in Calving interval which saves time, labor cost and effective dairy farm management. Moreover, old reproductive management is too expensive and it becomes the root of the loss of milk and meat production. It is also costly in case of labor, feed, and estrus detection, long inter calving interval, postpartum estrus detection and other disease problems. To get rid of these expensive traditional practices ART has developed many methods to control estrus cycle physiology and endocrinology. Estrus synchronization tools developed in recent breeding management programs of dairy herds in dairy industries have become an essential part of reproduction. Many of them rely on protocols that allow timed artificial insemination (TAI) to overcome the practical anomalies during estrus detection. Currently developed programs consist of protocols that are used for re-synchronization following first or consequent inseminations. Many programs include scheduled injections of Prostaglandin ($PgF_{2\alpha}$) and Gonadotropin-releasing hormone (GnRH). Meanwhile, progesterone and estradiol based supplements are also required in many techniques. The main program used for synchronization is "Ovsynch" protocol. Moreover, this review is based on the introduction, history, principles, factors and methods of estrus synchronization that are mostly used for profitable dairy farming, it will assist in the understanding of the basic mechanism that is involved in the control of estrus cycle.

Keywords: Estrus Synchronization, Estrus Cycle, Presynch, Ovsynch, Cosynch, Select Synch, Heatsynch, CIDR, PRID, MGA

Introduction

The world is suffering from an acute shortage of protein and carbohydrates especially developing countries due to the increasing population growth curve (Macmillan, 2010). To meet these global demands there is a dire need to improve the dairy and meat production by improving the performance of our indigenous and exotic livestock breeds. Daily animal production reduction is greatly influenced by several factors for instance management, climate change, nutrition and pathological changes. In such cases to get optimum results, it is of paramount importance to work on the reproductive efficiency of livestock (Suman et al., 2015). Several reproductive strategies have been developed to get maximum production from animals at a sustainable cost. For instance, estrus synchronization and efficient artificial insemination is being practiced at a commercial level and to some extent at the smallholder level.

Traditionally reproductive management is costly and faces a lot of challenges regarding labor, feed, estrus detection, long inter-calving interval, postpartum estrus detection and other disease problems (Anyam, 2006). To overcome these challenges modern reproductive management tools have to be followed. For that reason, onset of puberty age and regular estrus cycle manipulation is very important to control the estrus cycle physiology and endocrinology. Past research literature gives numerous recommendations to control the estrous cycle to accommodate the use of AI (Fricke et al., 2014).

Islamic Republic of Pakistan is at fifth rank in livestock production and the 9th largest meat producer country in the world. Livestock is the largest subsector in the agriculture economy of Pakistan, contributing 11.6% of total GDP and 60.1% in agriculture value during the fiscal year 2021. Almost 8 million families from rural areas rely on livestock production and generate more than 35-40% of their livelihood from this source. The gross value of livestock has almost increased to Rs. 1,505 billion (2020-21) from Rs. 1,461 billion (2019-20), with the uplift of 3.0 percent (GoP, 2020). Despite of this, having such a huge population of animals there is very little production of milk and meat per animal due to a lack of technical and governance assistance to livestock farmers. And work on scientific management and reproduction is underestimated due to a lack of confidence by owners. Efficient artificial insemination and timely ovulation can be accomplished by inducing the estrus and ovulation in anestrus cattle and by synchronizing estrus and ovulation in a group of females at a pre-determined time. This will result in efficient conception rates and reduce the calving interval (Anyam, 2006).

Improper detection of estrus is the basic reason for the low insemination rate, sterility and infertility in dairy farming. Timed artificial insemination (TAI) protocols are used to synchronize follicle growth, corpus luteum (CL) regression and ovulation contribute to improved reproductive performance because all animals are inseminated whether they are showing estrus or not (Colazo et al., 2014).

The purpose of the current review is to compile a metadata containing information on estrus synchronization and the methods/techniques used for Assisted Reproductive Technologies for better dairy management.

Synchronization of estrus in bovines: history

In the middle of the 20th century around 60 years back, work on artificial insemination was going to be practiced at a commercial level and research was at the peak level. Before this scientists faced various challenges to be successful in a proper understanding of estrus, ovulation, estrus cycle and postpartum interval to achieve optimum conception rates by breeding via A.I (1930 trough 1960s) and hormonal factors influencing on the life of corpus luteum in cattle (1950s through 1980s). Further research studies on the use of gonadotropins and progesterone from the 1940s to 1960s to regulate the estrus cycle in cattle, established an idea of estrus synchronization. Excellent results of estrus synchronization were detected with the long-term progesterone but the conception rate was not satisfactory (Lauderdale, 2009). In 1967 commercial research was directed at developing cheap and commercially available short-term progestogen products (such as Repromix, melengestrol acetate, Synchro-Mate-B, and CIDR). An intravaginal progesterone insert has been developed since 1976 which uses a combination of progesterone and $PGF_{2\alpha}$for more precise synchronization of estrus with a satisfactory conception rate. CIDR was the first time in 1987 recommended to be inserted for 12 days in New Zealand but the latest studies suggest variable duration e.g. 5, 7, 9, 12, & 14 days (Chacher et al., 2017). With the discovery of properties of another important hormone like compound in the early 1970's, prostaglandins (PGF2-alpha) revolutionized the estrus synchronization procedure. PGF2-alpha products were approved for estrus synchronization from 1970s to 1980s (Mapletoft and Hasler, 2015). During 1970s and 1980s GnRH products were also approved to treat ovarian follicular cysts in cattle. Later in the 1990's synchronization of follicular growth was reported by the use of estradiol and GnRH (Gonadotropin Releasing Hormone) which soon opened door to the development of various techniques to synchronize the ovulation process in cattle (Lauderdale,2009). Advance in research from 198 0 through 2000 led to understanding the follicular waves along with the timing of follicular recruitment, dominance and selection which was very important to control follicular growth to do timed artificial insemination successfully (Rodriguez-Martinez, 2012).

What is estrus synchronization?

In agriculture estrus synchronization (Gr. Syn= the same, common+ Chronos= time) is used (particularly in the dairy and beef industries) to facilitate breeding by A.I. Estrus synchronization is a technique in animal reproduction that is used to bring a large group or herd of female animals into estrus during a short, predetermined interval by manipulating their reproductive cycle without affecting the fertility of animal (Fesseha, and Degu, 2020). The mystery of synchronizing cows and heifers is to manipulate the estrus onset by managing the duration of the reproductive cycle (Chaudhari et al., 2018). For that purpose various endogenous and exogenous products have been developed (Bridges, et al., 2010).

Principles of synchronization

Generally, there are two principles of estrus synchronization in cows that prove feasible by altering the normal duration of the estrus cycle ranging from 18-21 days (Bekuma, and Ketema, 2019). Principles include;

i. Extension of luteal phase by maintaining the corpus luteum.
ii. Shortening of luteal phase by regression of CL

Factors affecting synchronization

Several factors influence the synchronization throughout the process. Major factors causing low pregnancy rate (20.18%) from synchronization programs include; lack of access to AI and awareness to farmers, sire selection, poor estrus detection and poor management system (Gatew 2016). Poor estrus detection may be due to the following factors (i) improper management of routine timing for estrus detection. (ii) Mainly mounting activity occurs at night in loosely housed herds. (iii) Short Heat periods (iv) There is a reduced level of estrus activity when a low no of cows are in heat. This may be a critical problem in the small dairy herd and in groups of cows in the large dairy herd where many cows are either pregnant, not cycling, or in the luteal phase of their estrus cycles. (v) Mounting continues for 10 seconds or less. (vi) Feet and leg anomalies, slippery floor, heat stroke, winter cold and other environmental factors reduce estrus and estrus cycle activity (Fesseha, and Degu, 2020). Other factors associated with estrus synchronization success are ovulation and AI time combination, calving season is considered to create a favorable physiological environment for applied reproductive strategy. It is essential to think of it as a gateway that should be implemented to ease in carrying out other management practices. Embryonic loss occurs gradually post-fertilization with maximum chances between days 15 and 18 after AI or natural mating, resulting in pregnancy loss and economic devastation. Pre-pubertal and postpartum anestrus period has been described as the principle factor that reduces the reproductive fertility in beef cow-calf (Lewis et al., 2016). Good body condition score preferably 5 or greater than this is 50 days or greater after parturition at the time of insemination. Cattle must be cycling, prevention and treatment of diseases, and control of parasites is important. Cost factors in multi-disciplinary stakeholders consist of animal production experts, breeders, labor, feeds and nutrition experts, veterinarians, and AI technicians along with this, the capacity building of farmers is of major concern. In the case of natural service bull to cow ratio is considered. Researchers recommended that one bull can be used to service 25 synchronized females. Bull's age, experience, and body conditions are of paramount importance in sire selection for synchronization to be successful. Proper administration and timing of treatments are essential for the success of any protocol (Bekuma, and Ketema, 2019).

Hormones required for estrus synchronization

1. Prostaglandin F2α

A naturally occurring stable prostaglandin that signal the CL (corpus luteum) to degenerate (luteolysis) in non-pregnant cattle, returning animal to standing estrus (Lopez-Gatius, 2021). It is secreted by the ovary after maturation of CL and it functions only when animal is in di-estrus (day 7 to 17 of estrus cycle) stage of the luteal phase having functional cl (Murugavel et al., 2003). Prostaglandin causes a fall in progesterone level which results in the increased concentration of FSH and LH causing estrus and ovulation when administered in the luteal phase. ProstaglandinF2α given during days 0 to 5 of the bovine estrus cycle do not elicit signs of estrus. It can cause abortion during the first 120 days of pregnancy hence animal must be examined for pregnancy before its administration (Lamb et al., 2006, Chanyalew et al., 2018). Failure of the drug in anestrus or noncyclic cows to manipulate estrus is another main limitation not used in dairy cows (Murugavel et al., 2003).

2. GnRH

GnRH (gonadotropin-releasing hormone) is a natural pituitary hormone used to manipulate the estrogenic phase of the estrous cycle. Luteinizing hormone (LH) secretion is stimulated by GnRH causes the rupture of dominant follicle (DF) and results in ovulation even in the presence of progesterone (P4). Fertile estrus cycle has not been established in young heifers yet that's why GnRH treatment is not recommended for them and has no consistent response to this hormone injection in pre-pubertal heifers (Lamb et al., 2006, Chanyalew et al., 2018).

3. Progesterone and Progestin

Progesterone is considered a pregnancy hormone (Chacher et al., 2017). It is secreted from CL and placenta to maintain the pregnancy (Murugavel et al., 2003). Progesterone inhibits the ovulation and estrus by suppressing LH, but when CL shrinks in size then P4 secretion falls, allowing animal to return into standing estrus. Progestins, however, imitate the natural progesterone regulating the estrous cycle by extending the luteal phase of the cycle but have a lesser effect than CL-generated (Colazo et al., 2014). Introduced progestins cause the follicles to grow instead of waiting till the exhibition of standing estrus and ovulation after natural regression of CL. They also induce estrus and ovulation in anestrus cows (Murugavel et al., 2003), (Lamb et al., 2006, Chanyalew et al., 2018).

Methods of estrus synchronization

1. Prostaglandin based estrus synchronization

Prostaglandin F2-alpha is a stable prostaglandin produced from ovary controlling the regression of corpus luteum in normal healthy non-pregnant cycling cows (Channo et al., 2022). Luteolysis is characterized by a decrease in plasma progesterone level and development of follicles along with an increased concentration of estradiol. There are generally two prostaglandin protocols used for efficient synchronization however results vary to at a greater extent. But the mechanism of both protocols is to reduce the duration of the luteal phase and return to the follicular phase earlier than the natural period of di-estrus stage of luteal phase (Chanyalew et al., 2018). The use of prostaglandins for estrus synchronization has led to conception rates (CR) of 12.5%-60% and estrus rates (ER) of 60-80%in buffalo heifers and ER of 70-100% and CR of 40-80% in adult buffaloes (Purohit et al., 2019). PGF2α injection on day 10 of the estrous cycle stimulated 100% estrus response in repeat breeder cows (Selvaraju 2020).

a. One Short Prostaglandin

One short protocol means only a single dose of PGF2-alpha is used to synchronize the female and inseminated on following estrus expression. Females injected with prostaglandins on day zero are visually observed for estrus signs (such as mucus discharge, uterine and cervical hyperemia, swollen vulva, stands to be mounted or mounting on other animals) and inseminated (Chanyalew et al., 2018). The limitation of the protocol is that one-third of the females do not give response to the treatment. This method can be modified with the estrus detection in the cows of the population for five days and inseminated on estrus expression. The remaining cows are injected with a single dose of prostaglandin. It represents the cost-effective in labor and treatments because only once injected and not all the cows need it (Yizengaw, 2017; Islam, 2011).

b. Two Short Prostaglandin

In two short methods, the first dose of Prostaglandin (PGF2α) is injected into a group of females at day zero. Some females will show estrus signs within 48 to 96 hours post-injection while others do not show any sign at all (Roy et al., 2020). Just observe for estrus; do not breed at this level. After 10 to 14 days of the first dose, administer another dose of PGF2α to those cows that did not respond to the first dose. Post 48 to 96 hours of the second dose all animals will be found in estrus. Now this is time to either mate or inseminate according to estrus or fixed time insemination 48 to 72 hours past the second PGF2α. This option is cheap and easy but results in the division of animals into two synchronized groups despite one and a longer breeding period (Yizengaw, 2017; Islam, 2011).

2. GnRH and PGF2α combined protocols

There are primarily three combinations namely ovsynch, cosynch and select synch protocols. These combinations are generally written in acronym G-P-G indicating GnRH-PGF2α-GnRHrespectively. These techniques have been elaborated for timed artificial insemination (TAI) (Fernandez-Novo, et al., 2021). The advantage of GPG protocol includes not only efficient synchronization but cystic ovaries can also be treated (Channo et al., 2022; Gvozdić et al., 2013).

2.1 Presynch

The Presynch protocol uses two injections of PGF**2**α at the interval of 14 days in cycling animals. After 14 days of the 2nd PGF**2**α injection, these cows will respond to the first GnRH injection in any of the GnRH-PGF**2**α (Ovsynch, Heatsynchor Select Synch) based combinations. Prior results of pregnancy rates using Presynch before Ovsynchfound, were improved by 10-20 %. In presynch protocol, the pregnancy rate recorded was 40 to 50 percent (Gvozdić et al., 2013; Velladurai et al., 2015).

2.2. Ovsynch protocol

In ovsynch, first GnRH is administered on any day of the estrus cycle (Preferably on 6th), and PGF2α is administered 7 days apart from the first GnRH (Fernandez-Novo, et al., 2021). The second GnRH is administered 48 hrs after PGF2α and animals are inseminated 12 hrs (range of 8-18hrs) after second GnRH (Gvozdić et al., 2013; Melendez, et al., 2006).

This program is mainly successful for cycling lactating cows but not in the case of heifers and anoestrus cows. In several previous studies, Ovsynch protocol was found effective to improve fertility of repeat breeder cows resulting in 55% pregnancy rate. This protocol is also very much helpful for the treatment of cystic ovarian disease where 66.7% pregnancy rate was achieved (Karki et al., 2018). In another study highest pregnancy rate 45% was recorded if cows were inseminated 16 hours after the second GnRH injection (Islam, 2011). However overall pregnancy rate in Ovsynch in dairy heifers was found 87.5% and when heifers were treated with the Ovsynch protocol had a 31.3% conception rate at first service (El-Zarkouny, 2010). The first injection of GnRHmodifies follicular growth by bringing ovulation of the dominant follicle after the GnRH injection to give rise to a new or additional secondary CL (Pursley et al., 1995). The ovsynch is the most frequently used GnRH based estrus synchronization protocol in buffaloes with CR of up to 60% during the breeding season and 11-20% in non-breeding season (Purohit et al., 2019). Ovulation with the Ovsynch protocol come about 24 to 32 hours following the second GnRH injection and 87 to 100% of lactating dairy cows can be synchronized (Patterson et al., 2003; Pursley, et al., 1997). Cows that were inseminated at a fixed time following Ovsynch ranged from 32 to 45% pregnancy rates (Patterson et al., 2003; Pursley et al., 1998). Ovsynch protocols are practiced to increase service rate and decrease days open and culling for infertility (Tenhagen et al., 2004).

2.3. Cosynch

The Co-Synch protocol includes an injection of GnRH on day 1 followed by an injection of prostaglandin on day 7 or 8 and then a second injection of GnRH while mating on day 9 or 10 (Chaudhari et al., 2018; Islam, 2011). Very small reduction in the pregnancy rate is reported for the cosynch than ovsynch (Velladurai et al., 2015; DeJarnette, and Marshall, 2003) Geary et al., 2001; Pursley et al., 1998). This protocol is widely used in beef cattle (Chaudhari et al., 2018). The advantages of this protocol include tight estrus synchronization, most females respond to treatment and also bringing non-cycling cows into estrus that are not less than 30 days postpartum (Islam, 2011). The pregnancy rates in co-synch ranges are between 40 and 50 percent (DeJarnette et al., 2004).

2.4. Select Synch

Select synch is a simplest GnRH-PG based protocol. Cows synchronized with this protocol are inseminated 12 h after estrus expression. A single doses of GnRH and Prostaglandin .is administered on days 1 and 7, respectively. Some cows (8%) exhibit estrus up to 48 hours before PGF (d 6). The peak estrus response occurs 2-3 days after PGF2-alpha with a range of 1-5 days (Chaudhari et al., 2018). Select synch saves cost second GnRH because only non-responding cows are administered. This protocol will allow us to use genetically superior semen in females in standing heat and to use less expensive semen for the timed artificial insemination. In all these techniques, the first GnRH causes ovulation in only 44-55% of dairy cows, therefore ovulation following the second GnRH may be poorly synchronized resulting in poor pregnancy rates. Dairy heifers' show55.9% conception rates in the first service and an overall pregnancy rate recorded 97.0% (El-Zarkouny, 2010).

2.5. Heatsynch

Heatsynch is an advanced technique that replaces the second GnRH injection in the ovsynch protocol by using the less expensive hormone oestradiol cypionate (ECP). Estradiol benzoate has been developed to synchronize ovulation (Dailey et al., 1986). Estradiol cypionate (ECP) has been approved to be used in lactating dairy cows. Present results utilizing dairy heifers show that ECP can replace the second GnRH injection in TAI to successfully cause ovulation, when administered 24 h after the injection of PGF2α. It has been reported that dairy heifers and non-lactating dairy cows ovulate 62 and 60 hours after ECP injection, respectively. Therefore, the interval to fixed-time AI is 72 hours after PGF**2**α (48 hours after ECP) for Heatsynch (Pancarci et al., 2002). In 75% of estradiol-treated cows submitted to the Heatsynch protocol, ovulation occurred between 48-72h (Gvozdić et al., 2013). In research studies, pregnancy rate for heatsynch was recorded 30-40% (Velladurai et al., 2015).

Progesterone treatment

Progesterone-impregnated intra-vaginal inserts designed in 1970's (Bridges et al., 2014) are available in most countries throughout the world and are being commonly practiced nowadays (Colazo et al., 2014). Most commonly practiced devices include CIDR (1.38 g of progesterone), PRID Delta (1.55 g of progesterone) and Cue-Mate (1.56 g of progesterone). Initially, the length of the original progesterone treatments aimed to rise in the plasma progesterone level was 12 days. But the label directions for AI recommended that the device should not be placed in vagina for more than 6 or 7 days. Injection of PGF should be administered 24 h before or at the time of device removal and observed for estrus signs 48 h later (Colazo et al., 2014). After the device removal, the declining progesterone level encourages follicular maturation followed by ovulation (DeGraaff and Grimard, 2018). Combined protocols with prostaglandins, eCG, oestrogens or with GnRHand timed AI shows synergistic effect (Souza et al., 2009). Anestrus buffalo heifers (Purohit et al., 2019) and cows in the postpartum period are more suited to progesterone treatment for estrus synchronization. Timing of estrus onset in progesterone-based synchronization protocols shows less variation as compared to prostaglandin-based methods (McNally et al., 2014). Progestins favor timed TAI estrus synchronization by urging cyclicity in prepubertal heifers (French, et al., 2013) and 14-d progestin subjection can generate greater estradiol 17-β levels 48 hour after prostaglandin (PG) F2α than 7-d exposure (Leitman et al., 2008). Synchronizing follicular waves in heifers is more difficult than in cows because of diminished response to GnRH (Atkins, et al., 2008; Moreira et al., 2000). Therefore, it is advisable to incorporate a longer-term progestin (e.g., 14 vs. 7 d) to induce estrus cycle in pre-pubertal heifers (French, et al., 2013).

CIDR INSERTION (Controlled internal drug release)

CIDR is a synchronization tool used to insert progesterone either alone or in conjunction with other hormones into vagina for a certain period. CIDR itself is a T-shaped device with flexible wings that are compressed to form a rod upon application by an applicator into vagina. Tail is attached to opposite side of insert to ease in removal of device at the end. The backbone of the CIDR is a nylon spine covered by progesterone (1.38g) impregnated silicone skin. After insertion blood progesterone level rises usually for seven days (Fesseha, and Degu, 2020) and 14 days (Abdalla wi et al., 2020) th maximal concentration attained within an hour of insertion and decreased upon removal of insert. It has been demonstrated that when a CIDR is placed into ovariectomized cow or female in the early estrogenic phase of the estrous cycle, progesterone concentrations will rises by 500% to 600% within hour after insertion (Arndt et al., 2009). Zaabel, et al., (2018) also got 43% and 85% conception rates, by placing CIDR for 7 and 14 days respectively (Zaabel et al., 2018). Inserts cannot be reused because critical care and hygiene with precautionary measures need to be followed

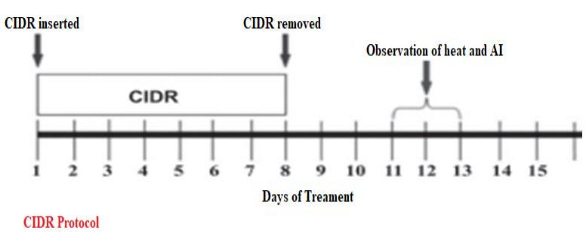

Figure 1. CIDR Protocol (After Vikash et al., 2014)

throughout the protocol to prevent contamination and vaginal infections (Fesseha, and Degu, 2020).

a. CIDR alone

Per vaginal CIDR insertion for 7 (Chaudhari et al., 2018) or 8 days (Vikash, et al., 2014) and then animals are monitored for 2-6 days to detect the estrus and insemination on heat expression (Chaudhari et al., 2018).

b. CIDR-PG protocol

In this combination, CIDR device is inserted into the vagina of animal on day 1 of the treatment and removed on day7 (Patil et al., 2021) or 8 (Vikash et al., 2014). One day before (Patil et al., 2021) or at the time of device removal an injection of (PGF2-alpha) is given intramuscularly and heat is observed for 2-6 days (Chaudhari et al., 2018). While females are bred 8 to 12 hours after observed estrus for the next three to five days or at a single fixed time 48 to 64 hours after CIDR removal (Patil et al., 2021). Research has shown that CIDR is very effective to synchronize estrus in both cycling & non-cycling cows & heifers.

c. CIDR- GnRH Protocol

In CIDR-GnRH program, CIDR is placed into vagina of animal for seven days and heat is observed for 2-6 days. If animal shows estrus then AI is done 12 h after showing heat and an injection of GnRH (Receptal 2.5 ml) is given through I/Mroute 12 hours before insemination (Chaudhari et al., 2018; Vikash, et al., 2014).

d. CIDR- PMSG (eCG) Protocol

CIDR device inserted into the vagina of animal on day 1 is removed on day eight. A freshly reconstituted Folligon® 2.5 ml (PMSG) is administered intramuscularly at the time of CIDR removal. Animals have inseminated artificially on showing estrus signs (Vikash, et al., 2014).

e. CIDR- GnRH – PG Protocol

In this protocol injection of GnRH is administered along with CIDR insertion on day 1 of the treatment. And on day 8, following the device removal, an injection of PGF2-alpha is given intramuscularly. In the last animal is inseminated 12 hour post heat detection (Vikash, et al., 2014).

f. CIDR- GnRH - PG- GnRH / CIDR-GnRH FT AI/ CIDR Ovsynch Protocol

This is a synchronization protocol in which intravaginal insertion of CIDR and an injection of GnRH is administered on day 1 followed by device removal on day 8 with an injection of prostaglandin F2-alpha. After three days second dose of GnRH is administered and AI is done with a gap of 0 to 12 hours following the second GnRH injection (Vikash, et al., 2014).

PRID (progesterone releasing intra-vaginal device)

PRID-Delta is a triangular shaped device with surface area of around 155 cm^2 and loaded with 1.55 g of progesterone (Van Werven et al., 2013). PRID containing P4 (1.55 g) and Estradiol benzoate (10 mg)

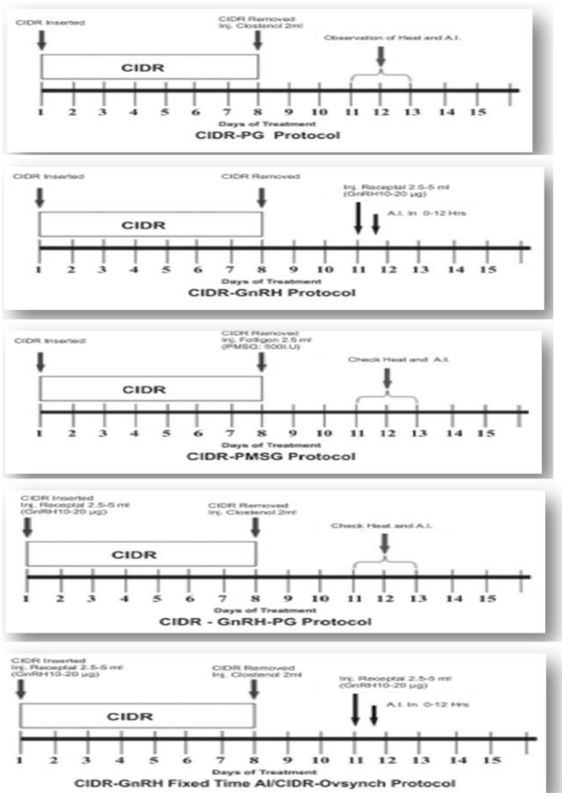

Figure 2. Different CIDR Protocoles (After Vikash et al., 2014).

combinations can be used to treat cystic ovarian disease (Channo et al., 2022) in postpartum animals. The device is inserted for 12 days intra-vaginally (Zulu et al., 2000). The majority of the animals show estrus signs 48 to 96 hours after device removal and then either bred according to estrus or fixed time insemination at 48 and 72 hours (Fesseha, and Degu, 2020).

MGA (melengestrol acetate) feeding

The original MGA-based protocol includes14 days MGAfeeding and serviced with a gap of 10 days (El-Zarkouny and Kesler, 2018). According to a study

Palpation	Palpation	Heat check	Palpation
Blood sampling	Sampling	AI	Sampling
PRID (in)	PRID(out)		
↓	↓	↓	↓
0d	12d	19d	19-26d

Figure 3. PRIDE insertion protocol (After Zulu et al., 2000).

MGA feeding for 9-14 days with the dose rate of 1-2 mg per day or in combination with an injection of 500 micrograms estradiol 24-48 hours prior to the last dose of MGA to buffalo heifers shown estrus rates in 62.7-100% females. However, conception rates were found only 35% (Purohit et al., 2019).

j. Malengesterol acetate +PGF2α

The MGA-based protocol recommended for heifers is MGA-PG. This tool requires more planning because it begins with MGA feed (0.5 mg/head/day) for 14 days (Patil et al., 2021) starting 33 days (Chaudhari et al., 2018) or 31 days (Patil et al., 2021) preliminary to PG injection. If MGA delivery is accurate, this is an effective protocol for beef heifers. The original suggested gap between the last feeding of MGA and PG injection is 17 days (Lamb et al., 2000). Delaying this interval to 19 days enhances estrus synchronization and would increase pregnancy rates to first service (Locke et al., 2020). This product is not recommended for lactating dairy cows (Patil et al., 2021).

Ear implants

Subcutaneous ear implants of synthetic progestogen (Norgestomet 3mg with 5mg estradiol valerate I/M) is kept in place for 8-10 days (Fesseha, and Degu, 2020) 9–12 days (Brar and Nanda, 2008). On the last day of implant after a dose of PMSG, fixed time insemination after 48 and 72 hours results in good fertility response (Fesseha, and Degu, 2020). Estradiol with P4 is used to initiate follicular wave development and ovulation at the end of the protocol. Following the withdrawal of the auricular implants buffaloes show estrus in 70-100% of females within 24-48 hours (Chaudhari et al., 2012). Timed insemination in buffaloes 64-68 hrs after withdrawal of norgestomet ear implants and administration of PG+ eCG before withdrawal during summer resulted in conception rates of 49.6% and similar conception rates were recorded in other trials on timed insemination in adult buffaloes following estrus synchronization with norgestomet in combination with eCG, PG and GnRH (Purohit et al., 2019).

Conclusion & Recommendations

Estrus synchronization is inevitable for profitable dairy farming, supporting in the understanding of the basic mechanism that is involved in the control of estrus cycle of animals. Old breeding management is very expensive, losing milk and meat production. Moreover, it is also costly in terms of labor, feed, and estrus detection, long inter calving interval, postpartum estrus detection and other disease problems. To get rid of these costly traditional practices, methods of estrus synchronization are very effective in dairy farming.

Conflict of Interest

The Authors affirm no conflict of interest.

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