EFFECT OF GONADOTROPIN RELEASING HORMONE AND PROSTAGLANDIN FOR IMPROVING REPRODUCTIVE EFFICIENCY IN GOATS

JULLIET

Thesis submitted in partial fulfilment of the requirement for the degree of

Master of Veterinary Science

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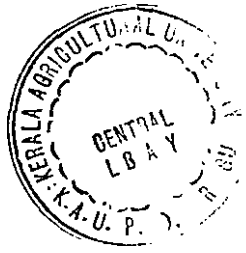

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DECLARATION

I hereby declare that this thesis, entitled **"EFFECT OF GONADOTROPIN RELEASING HORMONE AND PROSTAGLANDIN FOR IMPROVING REPRODUCTIVE EFFICIENCY IN GOATS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

We, the undersigned members of the Advisory Committee of **Julliet,** a candidate for the degree of Master of Veterinary Science in Animal Reproduction, agree that this thesis entitled **"EFFECT OF GONADOTROPIN RELEASING HORMONE AND PROSTAGLANDIN FOR IMPROVING REPRODUCTIVE EFFICIENCY IN GOATS"** may be submitted by **Julliet,** in partial fulfilment of the requirement for the degree.

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JULLIET

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LIST OF ABBREVIATIONS

AI	Artificial insemination
CL	Corpus luteum
CIDR	Controlled Internal Drug Release
eCG	Equine chorionic gonadotropin
EIA	Enzyme immunoassay
FGA	Fluorogestone acetate
GnRH	Gonadotropin releasing hormone
h	Hour
hcG	Human chorionic gonadotropin
i/m	Intramuscular
inj.	Injection
kg	Kilogram
LH	Lutenising hormone
LHRH	Lutenising hormone releasing hormone
MGA	Melengesterol acetate
ml	Milliliter
mm	Millimeter
ng	Nanogram
PGF2α	Prostaglandin F2 alpha
PMSG	Pregnant mare serum gonadotropin
P4	Progesterone
RIA	Radioimmuno assay
µg	Microgram
µl	Microlitre

Introductio

1. INTRODUCTION

Association of goats with mankind dates back to around 10,000 B.C. and they are the earliest livestock domesticated by man. Goats constitute a very important species of livestock in rural households in tropical countries by providing gainful employment to a large section of the rural poor and also by providing the much needed animal protein through their milk and meat (Bhatia, 2005). India ranks second among the countries of the world in goat population. The total goat population in the country is 124 million forming 16 per cent of the livestock population (FAO, 2001). India has around 20 distinct breeds of goat and they make a contribution of over rupees 1200 million to Indian exchequer every year by way of meat, milk, skin, fibre and manure. Further, goat meat and milk are considered superior in India than those from other species of domestic animals (Jindal, 1984).

Goat rearing is an important livestock enterprise in Kerala with 1.18 per cent of land area in India having 1.01 per cent of the goat population of the nation. On account of their short generation interval, higher rates of prolificacy, flexible feeding habits with an enormous potential to digest crude fibre and adaptability to tropical climate they are the best suited animals in our agro-climatic condition.

Achieving higher reproductive efficiency is the fundamental feature in economic animal rearing and techniques such as oestrus synchronization, superovulation, artificial insemination and embryo collection transfer technologies have proved highly useful for augmenting animal reproduction in the recent decades. Oestrus synchronization in livestock focuses on manipulation of reproductive cycles to improve their reproductive efficiency. It is an effective tool in planned breeding programme as it allows to breed animals at a determined time and hence parturition occurs at suitable times to take advantage of niche markets, feed supplies, labour and price trends.

Methods of oestrus synchronization in goats involve techniques such as alteration in photoperiodicity, using the buck effect and use of timed hormonal treatments either alone or in combination with photoperiodicity and buck effect (Lopez-Sebastian *et al.*, 2007). Oestrus synchronization using hormonal methods are of practical interest as the means of facilitating the application of AI in goats. The hormones used include gonadotrophins like equine chorionic gonadotropin (eCG) (Uphale, 1998), human chorionic gonadotropin (hCG) (Saharrea, 1998), prostaglandin alone or in combination (Romano, 1998) progesterone in oral, injection or implant form (Kusina, 2000), gonadotropin releasing hormone (GnRH) agonist (Whitley and Jackson, 2004) and melatonin (Dawson, 2007).

Artificial insemination in goats has been practiced in the AI Centre, under department of Animal Reproduction, College of Veterinary and Animal Sciences, Mannuthy for the last twenty years with variable results and it is a frequent observation that a good percentage of the goats presented for AI exhibit poor oestrus symptoms. Lack of awareness of the farmers about the various aspects of oestrus cycle in goats such as the duration of oestrus cycle, salient oestrus signs, duration of oestrum and the appropriate time for AI are the reasons behind this problem. Aggressive management strategies involving use of GnRH and $PGF_2\alpha$ has brought about revolutionary changes in improving the reproductive efficiency in cattle. But limited strategies in this regard were carried out in goats. Hence the present study was carried out to improve the reproductive efficiency of goats using GnRH and $PGF_2\alpha$ with the following objectives.

(1) To evaluate the effect of GnRH for favouring ovulation and improving conception rate in goats exhibiting pronounced oestrus symptoms.

(2) To compare the effectiveness of GnRH and $PGF_2\alpha$ protocol for improving reproductive efficiency in goats exhibiting poor oestrus symptoms.

(3) To determine the serum progesterone level in goats at various stages of treatment and to correlate it with fertility.

Review of Literature

2. REVIEW OF LITERATURE

2.1 BREEDING PATTERN IN TROPICAL GOATS

According to Mathew (1983) some seasonal tendencies existed in goats in Kerala with the period from June to November appearing to be the most fertile and accordingly November to April being the major kidding period with 65 per cent kidding occurring during this period. He opined that since the most favourable period of reproduction in goats was associated with rainy season in Kerala, the reduced period of day light, better forage availability and cool ambient temperature during this period contributed to this seasonal tendency.

In a similar study by Sharma (1985) in Jamunapari goats recorded 69 per cent and 68 per cent oestrus activity in June to July and October to November respectively. Goel and Agrawal (1994) found a difference in oestrus pattern between months and among breeds, with the highest incidence of oestrus observed in May to July and September to October in Jamunapari and Barbari goats.

However, Jainuddin and Hafez (2000) reported contrary to these findings. According to them in the temperate regions, goats can be classified as seasonally polyoestrus or short day breeders, while in the tropical zone, where variation in day length was less, indigenous sheep and goats tend to breed throughout the year.

Kutty (2005) in a study to evaluate the fertility of female goats across the seasons in Kerala found seasonal tendency with highest oestrus activity exhibited from September to November.

2.1.1 Length of Oestrus Cycle and Duration of Oestrus in Goats

Krishnakumar (1992) reported the length of oestrus cycle in Malabari crossbred goats of Kerala as 18-23 days. Goats were polyoestrus animals with an

interoestrus interval of 20-21 days; the duration of oestrus was 30-40 h, with the ovulation occurring spontaneously 12-36 h after the onset of oestrum (Gordon, 1997).

Jainudeen *et al.* (2000) reported that oestrus cycle was of 21 days in goats and oestrus lasts for 24-48 h with ovulation occurring 24 and 36 h after the onset of oestrus. They opined that abnormally short cycles were observed in the doe at the beginning and end of the breeding season, in the presence of the male and in the first breeding of young females possibly due to prematurely regressing corpus luteum (CL) or anovulation.

Goel and Agarwal (2002) reported that the duration of oestrus was 24 to 36 h in Jakharana goats with the mean oestrus duration averaging 27.97 ± 1.43 h at puberty and 29.28 ± 0.98 h at post puberty. Bhoosan and Kumar (2007) reported that the mean oestrus cycle length in goats was 21.33 ± 0.73 days, ranging from 19 to 23 days.

Smith (2007) reported that the duration of oestrus cycle in dairy goats was of 20 to 21 days. He opined that oestrus cycles were more erratic at the beginning and end of the breeding season and attributed the occurrence of short cycles of less than 12 days, often of only 5 to 7 days in young does to early luteal regression.

2.1.2 Oestrus Symptoms in Goats

Smith (1980) described the signs of oestrus in goats as swollen, reddened, and moist external genitalia and rapid side to side or up and down flagging of tail. Restlessness, tendency to be more vocal, and frequent urination were also observed.

According to Goel and Agrawal (1994) the salient signs of oestrus in goats were frequent bleating, wagging of tail, frequent micturition, teasing of other goats which are either in oestrum or non-oestrum, homosexual behaviour,

tendency to seek the buck and the vulvar discharge that was thin and watery during early estrum, mucinous during mid-oestrus and thick and cheesy in late oestrum.

Noakes *et al.* (2001) reported that the oestrus signs in goats comprised of slight vulval oedema and hyperaemia, frequent wagging of tail from side to side, increased vocalization, reduced appetite and milk yield and exhibition of mounting behaviour.

2.1.3 Follicular Dynamics of Oestrus Cycle

According to Gordon (1997) there were four follicular waves in the caprine oestrus cycle with ovulation occurring in wave 4 approximately 24 hours after the onset of the preovulatory LH surge and that follicular dominance was less noticed in goats than that reported in the cattle.

Castro *et al.* (1999) opined that caprine ovarian follicular development occurred in a wave pattern of 4 waves and that follicular dominance was less apparent in goats.

Medan *et al.* (2005) found that during the interovulatory intervals, follicular growth and regression occurred in a wave like pattern (2-5 waves) in goats, with the predominant pattern being three and four follicular waves. They further opined that follicular dominance was less apparent in goats.

2.2 OESTRUS SYNCHRONIZATION IN GOATS

Oestrus synchronization developed as a method for reducing the problems associated with oestrus detection and thereby increasing the utilization of Artificial Insemination. In addition, oestrus synchronization technology could be used to improve the management of reproduction and thus to improve the reproductive performance of the herd. According to Driancourt (2000) efficient oestrus synchronization treatment protocols should have the ability to effect the wave pattern by preventing the development of persistent dominant follicles

containing ageing oocyte and the recruitment of a new follicular wave, synchronous development of a new dominant follicle and ovulation at a predictable time. Oestrus synchronization in goats can be achieved by employing non-hormonal and hormonal techniques.

2.2.1 Non-Hormonal Techniques for Oestrus Synchronization

2.2.1.1 Use of Artificial Altered Photoperiod

Photoperiod manipulation was done by altering the day length, the decreased day length triggered the secretion of melatonin from the pineal gland which influenced the secretion of LH from the anterior pituitary and hastened cyclicity .Changes in light exposure required a minimum period of 60 days to induce cyclicity (Dawson, 2007).

2.2.1.2 Use of Male Effect

According to Wildeus (1999) oestrus could be induced in goats by exposure to the buck. He opined that the effect of the male proximity was mediated through changes in pulsatile GnRH release from the hypothalamus, selectively increasing tonic LH release.

2.2.2 Use of Hormones for Oestrus Synchronization

Oestrus synchronization using hormonal methods could be used practically for improvement of AI in goats (Whitley and Jackson, 2004)

2.2.2.1 Use of Progestogens

Oestrus induction and synchronization in cycling and anoestrus goats could be achieved by providing exogenous progesterone (Amoah and Gelaye, 1990). Exogenous progesterone exerted a negative feedback on LH secretion and following progesterone withdrawal follicular growth, oestrus and ovulation occurred with in 2 to 8 days. According to Wildeus (1999) the product of choice for oestrous synchronization in goats was the intravaginal sponge impregnated

with progestogens such as Flurogestone acetate (FGA) or Medroxy progesterone acetate for 9-19 days. Alternative choices were utilizing CIDR devices, Norgestomet implants and orally active Melengesterol acetate (MGA). Other hormones used in conjunction with progestogens were prostaglandin or analogue and a combination of gonadotropins like eCG or hCG.

2.2.2.2 Use of Gonadotrophin Releasing Hormone (GnRH) in Goats

Mcleod and Haresign (1984) reported that the administration of GnRH in seasonally anestrous ewes resulted in a pre-ovulatory LH peak at a mean time interval of 33.9± 1.8 h after the start of the treatment and that all ewes displayed oestrus and ovulated with a mean ovulation rate of 1.6± 0.13.They further opined that the fertility in the GnRH treated ewes was comparable to that obtained in ewes ovulating spontaneously during breeding season.

Singh and Madan (1986) found that administration of LHRH (GnRH) to a group of adult cycling Nali ewes resulted in decrease in the oestrous duration and cycle length. The duration of oestrus was 16 to 24 h compared to 20-40 h in the control group. Ovulation was 81.8 per cent in the LHRH group, with ovulation time from onset of oestrus being 24 h in the LHRH group, about 8 h less than in the control group.

Similarly Amoah and Gelaye (1990) found that administration of GnRH and PMSG at the withdrawal of priming agents greatly improved both induction of oestrus and ovulation in goats.

However, Robin *et al.* (1994) observed that intramuscular administration of GnRH in lactating goats primed with progestagen were less effective in regulating reproductive performance during anoestrous than infusions of PMSG. They reported that the onset of oestrus and the timing of endocrine events associated with ovulation were delayed in GnRH treated group compared to PMSG treated does.

Mee *et al.* (1996) concluded that pregnancy rates at first service accompanied by treatment with GnRH were not improved by altering either timing of AI or timing of hormone injection relative to the onset of oestrum.

According to Ullah *et al.* (1996) administration of GnRH at oestrus in lactating Holsteins during heat stress improved subsequent luteal function and progesterone secretion thereby enhancing embryo survival rates.

Perry *et al.* (2002) studied the effect of follicle size at the time of GnRH induced ovulation on luteal function and fertility in beef cows and reported that GnRH induced ovulation of smaller dominant follicles (<10mm in diameter) in the CO-Synch protocol did not effect subsequent CL formation and progesterone secretion but lead to increased embryonic death .

Pierson *et al.* (2003) found that administration of GnRH had no significant effect on the onset of oestrus, but it greatly improved the synchrony of the LH surge and ovulation in oestrus synchronized dwarf goats. The LH surge and ovulation occurred at a mean time of 26.0 ± 0.37 and 27.9 ± 1.0 h respectively after GnRH administration.

Mandal *et al.* (2004) studied the effect of day of GnRH administration on conception rate in buffaloes and reported that GnRH administration at estrus improved conception rate.

In a study by Husein *et al.* (2005) in progesterone primed GnRH- $PGF_2\alpha$ treated anoestrous goats found that GnRH injection induced the preovulatory LH surge, which induced ovulation approximately 24-30 h following its administration.

Ataman and Akoz (2006) found that administration of GnRH to ewes synchronized with GnRH- $PGF_2\alpha$ protocol improved synchronization rate, ovulation and reduced the variability of time to oestrus.

2.2.2.3 CO-Synch Protocol (GnRH- $PGF_2\alpha$ -GnRH +AI) for Oestrus Synchronization in Goats

Pursley *et al.* (1995) reported the pregnancy rates in cows treated with Ovsynch protocol as 50 per cent and that administration of $PGF_2\alpha$ 48 h prior to the second GnRH treatment in Ovsynch protocol resulted in higher conception rate than when PGF2α was administered 24 h and zero h before the second GnRH injection.

Twagiramungu *et al.* (1995) reported that GnRH and $PGF_2\alpha$ protocols in cyclic cows synchronized oestrus cycle in 70-80 per cent of the animals and reduced the time required for oestrus detection resulting in fertility rate in the range of 65-85 per cent.

Beck *et al.* (1996) compared the efficacy of GnRH- $PGF_2\alpha$ to double $PGF_2\alpha$ treatment in Welsh ewes and found that GnRH-$PGF_2\alpha$ protocols produced levels of oestrus synchronization and fertility comparable to those obtained under double $PGF_2\alpha$ regime.

Jemmeson (2000) opined that ovulation synchronization protocol was more effective over double $PGF_2\alpha$ protocol in dairy herds in which oestrus detection efficiency was poor or labour intensive nevertheless conception rate and pregnancy rates were better in the double $PGF_2\alpha$ protocol.

Lemaster *et al.* (2001) reported the pregnancy rate in cattle as 31.0 per cent and 35.5 per cent using CO-Synch and hybrid synch respectively, which was greater than 20.8 per cent obtained using the select synch protocol.

Lean *et al.* (2003) reported that Ovsynch protocol was not significantly different from double $PGF_2\alpha$ protocol in achieving conception, with overall conception rates of 37.6 per cent and 41.4 per cent respectively for each protocol.

Paul and Prakash (2005) reported that Ovsynch protocol in buffaloes resulted in ovulation to the extent of 90 per cent, within an average of 23.3 ± 1.3 h after the second GnRH treatment resulting in 33.3 per cent pregnancy rate.

Ataman and Akoz (2006) reported that GnRH- $PGF_2\alpha$ was more effective in synchronizing oestrus and improving fertility than double $PGF_2\alpha$ protocol in Akkaraman crossbred ewes with oestrous response as 93.3 per cent and 86.6 per cent and pregnancy rates as 85.7 per cent and 84.6 per cent for GnRH-$PGF_2\alpha$ and double $PGF_2\alpha$ protocols respectively.

Lopes *et al.* (2006) opined that large sized pre-ovulatory follicle and greater plasma oestradiol concentration on the day of AI were related to pregnancy in cows synchronized and inseminated under Ovsynch protocol.

In GnRH-$PGF_2\alpha$ -GnRH + AI (CO-Synch Protocol) breeding programme, the first injection of GnRH leutinized or ovulated mature follicles and initiated selection of a new dominant follicle. The administration of $PGF_2\alpha$ 7 days later initiated regression of the normal corpus luteum. A second GnRH injection induced ovulation within approximately 30 hours and allowed for insemination with or without the expression of oestrus (Pursley and Bellow, 2007).

2.2.2.4 Oestrus Synchronization in Goats Using Prostaglandins

Prostaglandins can efficiently synchronize oestrous and ovulation in cycling does. The effectiveness of prostaglandin in oestrus synchronization was dependent upon presence of a functional corpus luteum (Amoah and Gelaye, 1990). Both single and double treatment regimes could be used to synchronize oestrus.

2.2.2.4.1 Response to Prostaglandin Treatment

Pandey *et al.* (1985) conducted a study on oestrus synchronization in goats using double $PGF_2\alpha$ regime and brought 80 per cent non cycling, 86 per cent short cycling and 100 per cent nymphomaniac goats into oestrum, and they

reported the time interval for onset of oestrus following the administration of prostaglandin as a minimum of 54 h and a maximum of 286 h.

Singh *et al.* (1985) found that interval of onset of oestrus, oestrus duration and cycle length in adult cycling Nali ewes were reduced in prostaglandin treated group compared to progesterone treated and control group. Also ovulation was 100 per cent in the $PGF_2\alpha$ group against 88.8 per cent in progesterone group.

Amoah and Gelaye (1990) reported that the time taken from prostaglandin administration to oestrus was 55.3 h following a double dose of $PGF_2\alpha$ against 62.4 h after a single injection of prostaglandin in goats.

Kutty and Mathew (1996) evaluated the effectiveness of a single injection of $PGF_2\alpha$ by intravulvo submucosal route for oestrus synchronization in 20 does in luteal phase and reported 100 per cent oestrus response after the administration of prostaglandin.

Uphale *et al.* (1998) reported that double prostaglandin regime produced the same level of oestrus synchronization in Malpura ewes as when $PGF_2\alpha$ were used in the presence of different level of PMSG and the interval between treatment and oestrus exhibition was 24 to 120 h.

Wildeus (1999) reported that a double prostaglandin regime 11 days apart was the most effective approach for oestrus synchronization in goats and sheep with the mean time for oestrus onset being 46-48 h with 95 to 100 per cent does responding.

Bharali and Dutta (2001) conducted a study on oestrus synchronization in goats in mid luteal phase using single dose of $PGF_2\alpha$ and its three different combinations with human chorionic gonadotropin (at six hours post onset of oestrus) and pregnant mare serum gonadotropin (PMSG) and reported cent per cent oestrus response using different hormonal combinations.

Chede *et al.* (2002) in a study reported 63.40 per cent oestrus synchronization using double dose of $PGF_2\alpha$ administered 11 days apart. The animals exhibited oestrus signs 55.8 ± 2.22 h after the second dose of prostaglandin. They opined that the low response to hormone treatment might be due to variation in breed, plane of nutrition, environmental factors, managemental practices, and hormone profile in individual animals.

Senthilkumar (2002) compared the efficacy of prostaglandin-PMSG combination and prostaglandin alone on oestrus synchronization in 48 goats. He observed that 100 per cent of the animals came into oestrus when prostaglandin-PMSG was used against 91.70 per cent animals when prostaglandin alone was used.

2.2.2.4.2 Duration of Oestrus

Greyling and Van Niekerk (1986) synchronized oestrus in Boer goats using double dose of prostaglandin and reported that the oestrus duration was 41.90 h and 30.90 h after the first and second dose of prostaglandin respectively and the oestrus onset interval was 55.3 h after second dose of prostaglandin.

Selvaraju *et al.* (1997) conducted an experiment to study the effect of breeding on the duration of oestrus and found that shorter duration of 24.33 ± 1.58 h was observed in goats that were subjected to natural service compared to 31.33 ± 2.51 h in artificial insemination.

Goel and Agrawal (2000) reported that the mean duration of oestrus in goats was 34.50 ± 3.31 h in natural oestrus and 28.0 ± 3.26 h in prostaglandin induced oestrus.

Bharali and Dutta (2001) reported that the mean oestrus onset interval following prostaglandin administration was 46.33 ± 5.04 and the mean duration of oestrus in natural oestrus was 31 ± 1.75 h against 23.50 ± 0.99 h in $PGF_2\alpha$ induced oestrus.

Chede *et al.* (2002) found that the oestrus onset interval was 55.38 h after the second dose of prostaglandin and the mean duration of prostaglandin induced oestrus was 35.38 ± 1.55 h with a range of 24 to 48 h as against 24 h with a range of 20-24 h in natural oestrum.

Mean oestrus duration in Jakhrana goats averaged 27.97 ± 1.43 h at puberty and 29.28 ± 0.98 h at post puberty (Goel and Agrawal, 2002).

Average duration of oestrus in prostaglandin synchronized does was found to be 34.91 ± 4.97 h (Senthilkumar, 2002).

According to Afsal (2003) the mean duration of prostaglandin induced oestrum in does was 35.81 ± 0.86 h.

2.2.2.4.3 Intensity of Oestrus Behaviour in Goats

According to Mehta *et al.* (1991) bleating, switching of the tail, smelling of the perineum by the buck, and mounting aggressiveness by buck were the prominent signs of oestrus in goats while vulval swelling and vaginal discharge were not the consistent signs of oestrus in goats.

Goel and Agrawal (1994) found that vulval discharge was thin and watery during early oestrus, mucinous during mid oestrus and thick and cheesy in late oestrus in goats administered with prostaglandin through intravulvo submucosal route.

Kutty and Mathew (1996) reported 100 percent induction of oestrus in goats administered with prostaglandin through intravulvo submucosal route, however, only 25 percent of goats exhibited behavioral oestrus signs which included wagging of tail and standing to be mounted while rest of the treated goats failed to show any behavioural signs and failed to be detected by the buck.

Goats remained in oestrus for about 36 h and exhibited various oestrus signs, which were more pronounced in meat type breeds compared to dairy type

goats (Kumar and Yadav, 2000). They recorded signs of oestrus as frequent bleating, switching of tail, restlessness in seeking the buck, arching and stretching of the body, mounting and allowing mounting by other does.

Senthilkumar (2002) graded the intensity of oestrus in goats by giving score to behavioural sign and physiological changes associated with oestrus. Wagging of tail, vulval redness, and oedema were the predominant signs observed in these animals.

2.2.2.4.4 Fertility Following Prostaglandin Treatment

According to Singh *et al.* (1985) the lambing percentage in Nali ewes was 81.25 per cent, 66.6 per cent, and 16.6 per cent in the prostaglandin, progesterone, and control groups respectively.

Amoah and Gelaye (1990) reported that the pregnancy rates in goats treated with double prostaglandin treatment was 70.6 per cent following first service.

Shivkumar(1993) reported the conception rate as 85 per cent in does synchronized using $PGF_2\alpha$.

Kutty and Mathew (1996) reported a lower conception percentage of 15 per cent in goats following prostaglandin treatment against 20.8 per cent in the control.

Romano (1998) compared the effect of two doses of cloprostenol for oestrus synchronization and fertility in Nubian goats and found that fertility rates were similar for both groups.

Kusina *et al.* (2000) reported that double $PGF_2\alpha$ regime was equally effective to intravaginal progesterone sponges for oestrus synchronization and that the fertility rates were almost similar for both the groups at 64-83 per cent.

Noakes (2001) reported 44.4 per cent pregnancy rate in does following oestrus synchronization using double prostaglandin protocol.

Chede *et al.* (2002) reported 69.29 per cent fertility percentage in double $PGF_2\alpha$ treated group against 50 per cent for the control.

Gade *et al.* (2003) studied the ovulatory response and conception rate in goats synchronized with $PGF_2\alpha$ and found an average ovulation rate of 1.57 in treated group with conception rate at 50 per cent.

Singh *et al.* (2005) reported 88.88 per cent conception rate in the double $PGF_2\alpha$ treated group, while the conception rate was 80 per cent in the control group.

2.3 VARIATIONS IN RESPONSE TO SYNCHRONIZATION USING DIFFERENT HORMONE PROTOCOLS

Despite the increased response to hormone synchronization protocols, variations in synchronization rates were often encountered and this might be attributed to the stage of oestrus cycle at which treatments were initiated (Pursley and Bellow, 2007).

2.3.1 Variation in Response to GnRH Treatment

According to Singh and Madan (1986) administration of LHRH (GnRH) induced ovulation, however induction of precocious ovulation during follicular phase of the cycle curtailed time required for the potentiation of all ovulatory mechanism during the preovulatory phase resulting in immature egg production, poor fertilizing ability and low conception rate and thus opined that the treatment must coincide with normal endogenous release of LH for increasing rate of fertility and lambing.

2.3.2 Variation in Response to CO-Synch Protocol

Vasconcelos *et al.* (1999) opined that the major causes of synchronization failure in Ovsynch protocol in dairy cows were lack of ovulatory response to the first GnRH injection, atresia of the dominant follicle before $PGF_2\alpha$ administration and spontaneous luteolysis between administration of the first dose of GnRH fand $PGF_2\alpha$.

Peters and Pursley (2003) reported that the administration of the final treatment of GnRH in the Ovsynch programme at the same time as $PGF_2\alpha$ or in the 24 h following $PGF_2\alpha$ as against 48 h following $PGF_2\alpha$ affected ovulatory follicle size, subsequent luteal function and fertility in dairy cows.

Pursley (2007) reported that follicles that were induced to ovulate before attaining maturity level were less fertile and that smaller follicular size at the time of induced ovulation with GnRH resulted in lower conception rate.

2.3.3 Variation in Response to Double Prostaglandin Protocol

Ataman and Akoz (2006) observed absence of oestrus signs and follicular development following administration of the second $PGF_2\alpha$ injection in the double $PGF_2\alpha$ protocol in some ewes and attributed this to late formation of the corpus luteum and hence late luteolysis after the first $PGF_2\alpha$ injection or to insufficient sensitivity of luteal tissue to $PGF_2\alpha$.

2.4 PREGNANCY DIAGNOSIS IN GOATS

The early diagnosis of pregnancy was an important aspect of reproductive management of a dairy herd. It can affect profit through factors such as the amount of milk produced per day, decisions on culling and feeding regimes, and the identification of fertility problems (Dionysius, 1991).

2.4.1 Pregnancy Diagnosis in Goats Using Abdominal Palpation

Abdominal palpation is a cheap and simple method for pregnancy diagnosis in goats. The accuracy of the diagnosis increases as the pregnancy gets advanced.

Smith (1980) reported that the fetus could not be detected by abdominal palpation in goats before 110 days of pregnancy. He also described various methods of palpation such as attempting to touch both hands together through the animal's abdomen, encircling the abdomen with both arms and lifting upwards and abdominal ballottement.

Abdominal palpation in late pregnancy was possible in slab sided, thin relaxed goats, but was difficult in big bodied, strong willed goats as they resisted the palpation by tightening the abdominal muscles (Williams, 1986).

Goel and Agrawal (1990) conducted abdominal palpation in goats that were in natural standing position by pressing the abdominal wall on both sides to feel the fetal mass. They concluded that diagnosis by abdominal palpation was not possible at 51 to 60 days of pregnancy but the percentage of accuracy increased to 70 at 61-70 days, 90.3 at 71-80 days and 95.4 at 80 days and later.

Rajasekaran *et al.* (1992) used abdominal palpation as a method for pregnancy diagnosis in sixty-five goats at various reproductive stages. Percentage of animals diagnosed as pregnant, non-pregnant and doubtful were 27.5, 45 and 27.5 respectively. Out of the doubtful cases 71.4 per cent were diagnosed as pregnant and 28.6 per cent as non-pregnant by the use of X-ray.

Gordon (1997) opined that abdominal palpation could be used for pregnancy diagnosis in late pregnancy in slab-sided, thin, relaxed does. Also in a doe that was 120 days pregnant, the fetus could be palpated in either flank by using a gentle-closed fist technique.

According to Matsas (2007) pregnancy diagnosis in goats could be made during the last days of pregnancy by either palpating the gravid uterus or by ballottement of the fetus low in the right flank through the abdominal wall.

2.4.2 Pregnancy Diagnosis Using Serum Progesterone Profile

Akusu *et al.* (1984) reported the progesterone level determined using RIA method during oestrus, pregnancy, parturition and post parturition as 0.18 ± 0.04 ng/ml, 3.45 ± 0.12 ng/ml, 0.74 n/ml and less than 1 ng/ml respectively.

Baruah *et al.* (1987) reported the mean serum progesterone concentration by RIA technique on the day of oestrus and on the 4^{th}, 8^{th}, 12^{th}, 16^{th} and 20^{th} after oestrus in goats as 0.47 ± 0.04, 1.81 ± 0.07, 4.63 ± 0.17, 5.56 ± 0.12, 3.82 ± 0.13 and 0.50 ± 0.03 ng/ml respectively.

Pathak *et al.* (1990) reported the mean serum progesterone by RIA during oestrus in Surti and Marwari goats as 0.50ng/ml and 0.76 ng/ml respectively.

Pathiraja *et al.* (1991) measured progesterone by RIA and reported that progesterone level ranged from non- detectable levels on day of estrum to 5.2 ± 0.28 ng/ml at mid - cycle and the duration of elevated progesterone level (>2 ng/ml) was for about 12 days.

Dionysius (1991) reported the mean milk progesterone level using EIA as 0.44 ng/ml (range 0 to 2.8 ng/ml) and 20.7 ng/ml (range 6.5 to 35 ng/ml) during oestrus and pregnancy respectively in dairy goats. The accuracy of pregnancy diagnosis ranged from 80 to 88 per cent and that of non-pregnancy from 80 to 100 per cent.

Umberger *et al.* (1994) opined that blood serum progesterone concentration above or equal to 0.5ng/ml could be taken as an indicator of ovulation and corpus luteum formation.

According to Saharrea *et al.* (1998) premature luteal regression in goats can be considered to have occurred if progesterone concentrations declined to less than 1 ng/ml by day 6 of the oestrus cycle.

Castro *et al.* (1999) reported the mean serum progesterone concentration using RIA technique between day 5 and 10 as 5.9 ± 0.4 ng/ml and between days 15 and 17 of oestrus cycle as 3.7 ± 0.6 ng/ml in dairy goats.

Zarkawi and Soukouti (2001) concluded that serum progesterone levels determined by RIA technique were under 3.18 nmol/litre and above 3.18 nmol/litre during the follicular and luteal phase of oestrus cycle of indigenous Damascus goats.

Tandle *et al.* (2003) measured the plasma progesterone level using RIA in relation to the administration of exogenous therapy in ewes and reported the progesterone level as 0.28 ± 0.04 ng/ml and 0.30± 0.05 ng/ml at natural and induced oestrus respectively and further reported that consequent to the administration of prostaglandin the progesterone level decreased to 0.28 ± 0.54 ng/ml.

According to Matsas (2007) plasma progesterone concentrations above 1 ng/ml suggested functional luteal tissue but was not pregnancy specific as elevated concentrations could accompany hydrometra, pyometra, early embryonic death and fetal mummification giving false positive results.

2.5 GESTATION LENGTH IN GOATS

Mean gestation period in goats was reported to be 148 to 156 days (Roberts, 1971). Average gestation length in Malabari, Alpine x Malabari and Saanen x Malabari does was found to be 146.66 ± 0.53 days (Kuriakose, 1981). Prasanth (1995) opined that the average gestation period of 149.85 ± 4.45 days for Alpine x Malabari crossbred does Jainudheen and Hafez (2000) concluded that the average gestation length in goat is 150 days. Average gestation length

reported for tropical goat breeds is 145 days (range 149 -150 days) (Kusina *et al.*, 2000). Bhooshan and Kumar (2007) reported the mean gestation length in goats as 148.2 ± 1.67 days with a range of 143-151 days. Smith (2007) reported the average gestation length in goats as 147-155 days.

2.6 LITTER SIZE IN GOATS

The incidence of single, twin and triplet birth was 40, 48 and 12 per cent respectively in Malabari x Alpine crossbred goats with an average number of kids per kidding of 1.7 (Prasanth, 1995). Higher twinning percentage was reported in Boer goats maintained in Kerala (James *et al.*, 2002). The incidence of single, twin and triplet was 32.26, 58.07 and 9.68 per cent respectively in Malabari crossbred does (Afsal, 2003)

2.7 EFFECT OF HORMONE ON FERTILITY

Shivkumar (1993) found that average birth weight of kids born to synchronized and control does were not significantly different at 5 percent level. Yang Shenglin *et al.* (1999) reported that there was no significant difference in litter weight between goats treated with prostaglandin and without prostaglandin. Zarkawi (2000) evaluated the effect of two doses of prostaglandin $F_2\alpha$ analogue for oestrus synchronization and found no significant difference in the time to onset of oestrus, gestation length and birth weights in Syrian Awassi ewes.

Materials and Methods

3. MATERIALS AND METHODS

A total of 42 cycling Malabari crossbred does aging 2-4 years, with body weight between 25-40 kg maintained at University Sheep and Goat Farm, Kerala Agricultural University, Mannuthy, Thrissur were used for the study.

The does were maintained in the farm under semi-intensive system of management. Heat detection was carried out every day in the morning and evening by a vasectomised buck and natural breeding was practiced in the farm. The study was carried out in the year 2007 during the months October to December.

3.1 TREATMENT

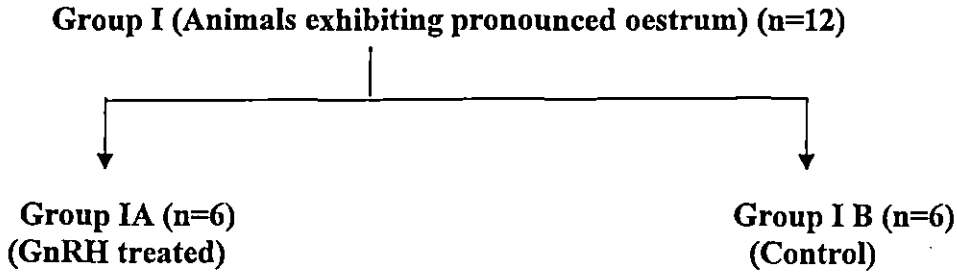
In does exhibiting oestrum, the associated behavioural and physiological changes were noted. A detailed clinico-gynaecological examination was carried out to observe physiological changes in the vagina and cervix.

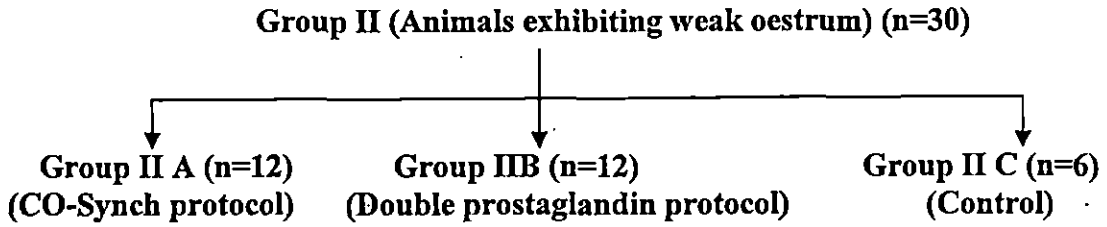
Based on the behavioural signs and clinico gynaecological examination, the following observations were made -

3.1.1 Intensity of Oestrus

The behavioural signs and clinico-gynaecological examination were used to grade the intensity of oestrum and the animals were then divided into two groups, viz., Group I and Group II.

Outline of the experiment is pictorially depicted below-:





3.2 GROUP I – ANIMALS EXHIBITING PRONOUNCED OESTRUS

Group I comprised of twelve animals exhibiting pronounced oestrum. This group was further divided into two subgroups namely Group IA and Group IB each comprising six animals and treated as follows:

3.2.1 GnRH Treatment Protocol

3.2.1.1 Group IA

The animals in Group IA received an intramuscular injection of 0.0042 mg of Buserelin (1 ml Receptal) a potent GnRH analogue on the day of oestrum followed by breeding.

3.2.1.2 Group IB

The animals in Group IB served as the control. No treatment was administered here. The does were mated on detection of oestrum.

To determine the serum progesterone level during oestrum, 5 ml of blood was collected by jugular venipuncture from all the twelve does. Time of sample collection was before GnRH administration and mating.

3.2.1.3 Duration of Oestrus

The period from the time of onset of oestrus signs to the end of the behavioural and physiological signs of oestrus was considered as the duration of oestrus. The duration of oestrus was observed for both Group IA (GnRH administered group) and Group IB (Control group).

3.2.1.4 Conception Rate

The conception rate was calculated for both Group IA and Group IB to analyse the effect of administration of GnRH at oestrus on fertility in does exhibiting pronounced oestrum.

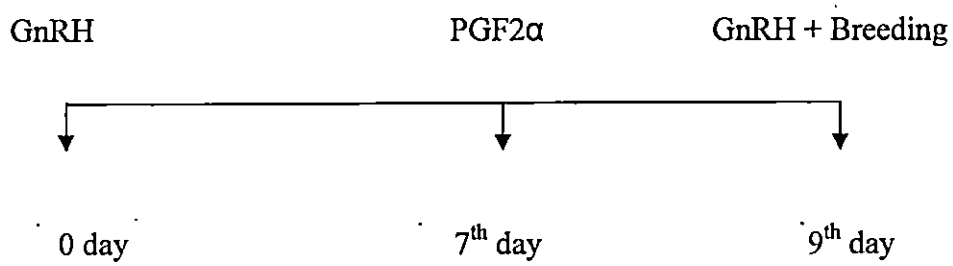
3.3 GROUP II – ANIMALS EXHIBITING WEAK OESTRUS

This group comprised of thirty animals exhibiting weak oestrus, and was further divided into three subgroups namely Group IIA, IIB and Group IIC each comprising of twelve, twelve and six animals respectively and were then treated as follows.

3.3.1 CO-Synch Protocol

3.3.1.1 Group IIA

This group comprised of twelve animals and was treated as per the following CO-Synch protocol.



Here, in this group each doe received a single intramuscular injection of 0.0042 mg Buserelin (1 ml Receptal*) an analogue of GnRH (Beck *et al.*, 1996) on the day of estrum (day 0), followed 7 days later by an intramuscular injection of 125 µg cloprostenol (0.5 ml clostenol**) an analogue of prostaglandin (Romano, 1998) followed by 0.0042 mg Buserelin and mating on day 9.

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* Receptal – VET Buserelin- Acetate Inj. (GnRH Analogue). Each ml contains 0.0042 mg buserelin acetate equivalent to 0.004 mg buserelin and, as antimicrobial additive, 1% benzyl alcohol as preservative. Supplied by Intervet , Pune, India

** Clostenol Cloprostenol injection B.P (Vet) (PGF2α Analogue). Each ml contains cloprostenol sodium 263 mcg equivalent to cloprostenol 250 mcg. Manufactured by Sarabhai Zydus, Vadodara, India

Animals if any, exhibiting oestrum after first dose of GnRH were bred and excluded from the protocol regime.

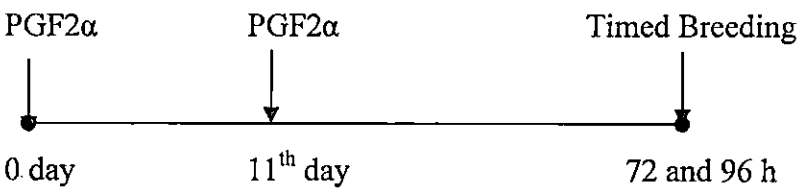
Five ml of blood was collected before the administration of treatment on day 0, 7 and 9 for determining serum progesterone profile.

3.3.2 Prostaglandin Protocol

3.3.2.1 Group IIB

This group comprised of twelve animals and was treated as per the following Prostaglandin protocol.

The pictorial depiction of double prostaglandin protocol is shown below-:



Here, in this group each doe was administered twice, at 11 days interval an intramuscular injection of 125 µg cloprostenol (0.5 ml clostenol) (Kusina *et al.*, 2000) followed by timed breedings at 72 and 96 h.

Animals, if any exhibiting oestrum after first dose of prostaglandin were bred and excluded from the protocol regime.

Five ml of blood was collected from each doe on days 0, 11 and days of timed breeding to determine the progesterone level. The samples were obtained prior to the administration of any treatment and mating.

3.3.3 Group IIC

This group constituted as the control, and comprised of six animals exhibiting weak oestrum. No hormonal treatment was administered in this group. The animals were bred following detection of oestrum.

Five ml of blood was collected from each doe to assay for the serum progesterone level during oestrum.

3.3.4 Fertility Study Following Treatment

3.3.4.1 Oestrus Response

The oestrus response was calculated in Group IIA and Group IIB as the number of does exhibiting oestrum following the administration of prostaglandin.

3.3.4.2 Oestrus Onset Interval

Each doe in Group IIA (CO-Synch protocol) and Group IIB (prostaglandin protocol) after the administration of PGF2α was closely observed for the onset of oestrus by using a vasectomised buck. The time interval between the administration of prostaglandin and the time of onset of oestrus was recorded as the oestrus onset interval.

3.3.4.3 Intensity of Oestrum

In Group IIA, and Group IIB the intensity of induced oestrum was assessed by assigning scores (Senthilkumar, 2002) to behavioural and physiological changes associated with oestrus.

3.3.4.3.1 Oestrus Signs and their Scores

Parameters	Score
Behavioural Signs	
Wagging of tail	2
Mounting on other animals	1
Bleating	1
Circling with the buck	1
Standing to be mounted	5

Parameters	Score
Physiological signs	
Vulval hyperaemia	2
Vulval oedema	3
Vulval discharge	5
Total	20

3.3.4.4 Duration of Oestrus

The duration of oestrus was observed for does in Group IIA, IIB and IIC.

3.3.4.5 Conception Rate

The conception rate was calculated in does in Group IIA, IIB and IIC. The conception rate in does that were excluded out of protocol was also recorded.

3.4 SERUM HARVESTING

All the blood samples following collection were kept undisturbed for one hour, followed by centrifugation at 2000 rpm for 10 minutes; serum was harvested and stored at –20°C until assayed for progesterone.

3.5 PROGESTERONE ANALYSIS

The serum progesterone level was determined for the treatment groups by RIA technique, as per the method of Immunotech (Muunotech SAS – 130 av.de Lattre de Tassigny – B.P. 177-13276 Marscille Cedex 9 France). The assay was carried out at Radio Tracer Laboratory, Kerala Agricultural University, Vellanikkara. RIA technique is designed for the direct, quantitative measurement in serum or plasma. A 100 tube kit contained 185 kBq (Kilobecquerels) of radioactive ^{125}I labelled progesterone. The sensitivity of the Assay was found to be 0.05 ng/ml (0.16 nmol/l). The intra-assay variations ranged from equal to or below 5.8 and the recovery percentages obtained were between 85 per cent and 110 per cent.

3.5.1 Principle

The radioimmunoassay of progesterone is a competitive assay. Samples and calibrators are incubated with ^{125}I labeled progesterone as tracer in antibody coated tubes. After incubation the contents of the tube is aspirated and bound

activity is measured. A calibration curve is established and unknown values are determined by interpolation from the curve.

3.5.2 Procedure

All the components in the progesterone assay kit and the samples were brought to room temperature before starting the procedure. To the antibody coated tubes 50 µl of calibrator and 500 µl of tracer were added. To two tubes 50 µl of control and 500 µl of tracer were added. 500 µl of tracer was added to two tubes to obtain total cpm and to all other tubes 50 µl of sample and 500 µl of tracer were added. The samples were then incubated for 1 hour at 18- 25 degree celcius in a vortex mixture with shaking at 350 rpm. After incubation the contents were aspirated out of the tubes and the tubes were decanted thoroughly by placing them on decanting racks.

3.5.3 Measurement of Radioactivity

Radioactivity was determined in a gamma counter by counting the count bound cpm and total cpm for 1 minute. A standard curve was drawn on a semi-logarithm graph paper by using a semi-logarithmic curve fit (spline mode) with bound cpm/ total cpm (%) on vertical axis and the progesterone concentration of the calibrators on the horizontal axis(ng/ ml). Results were obtained from the standard curve by interpolation.

The data was then statistically analysed as per the methods described by Snedecor and Cochran (1985).

3.6 PREGNANCY DIAGNOSIS

All the does were closely monitored everyday for observing any return to oestrum and pregnancy diagnosis was performed at three months of gestation using abdominal palpation method (Smith, 1980).

3.7 FERTILITY STUDY

Fertility of the inseminated does was assessed after kidding. Gestation length, litter size at birth and birth weight of kids were recorded in each group.

The results were statistically analysed as per methods described by Snedecor and Cochran (1985).

Plate.1. Malabari cross-bred experimental animals

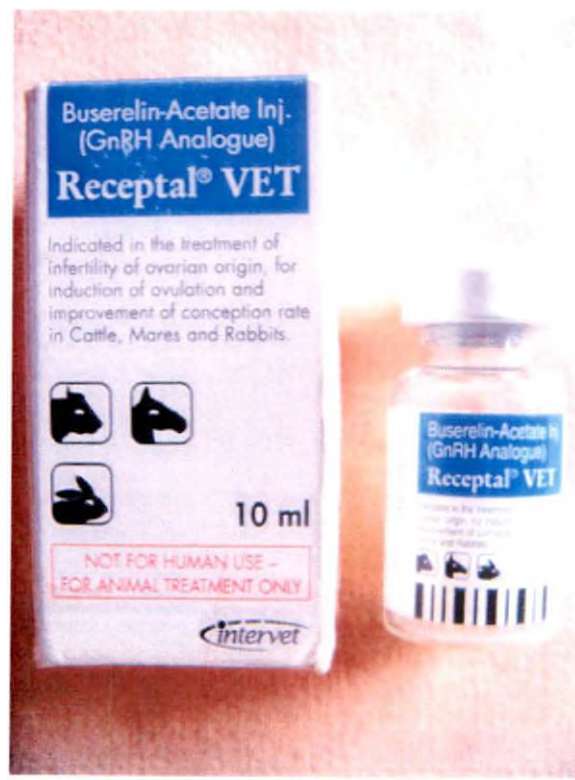


Plate.2. Inj. Receptal

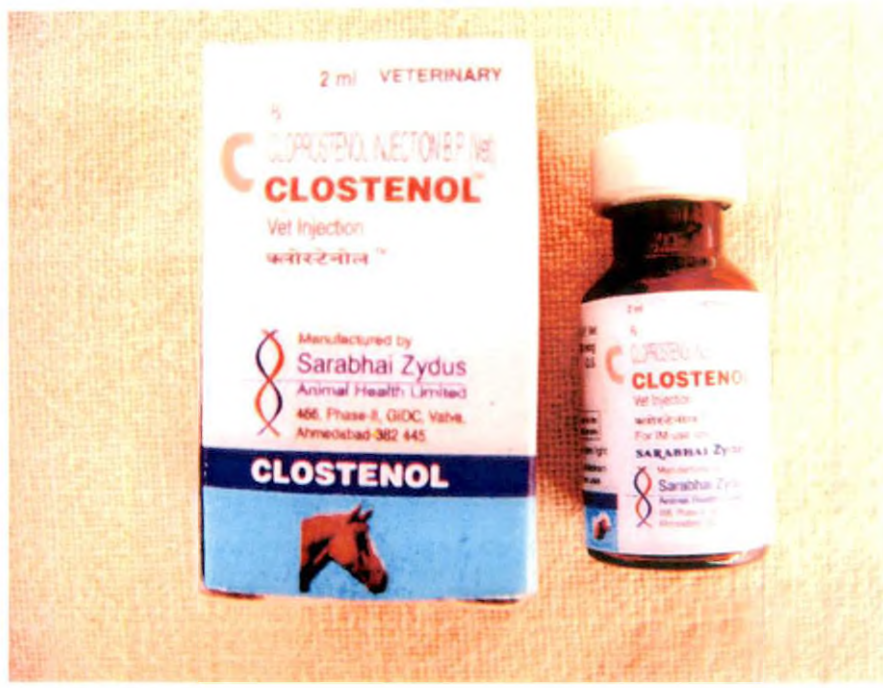


Plate.3. Inj. Clostenol

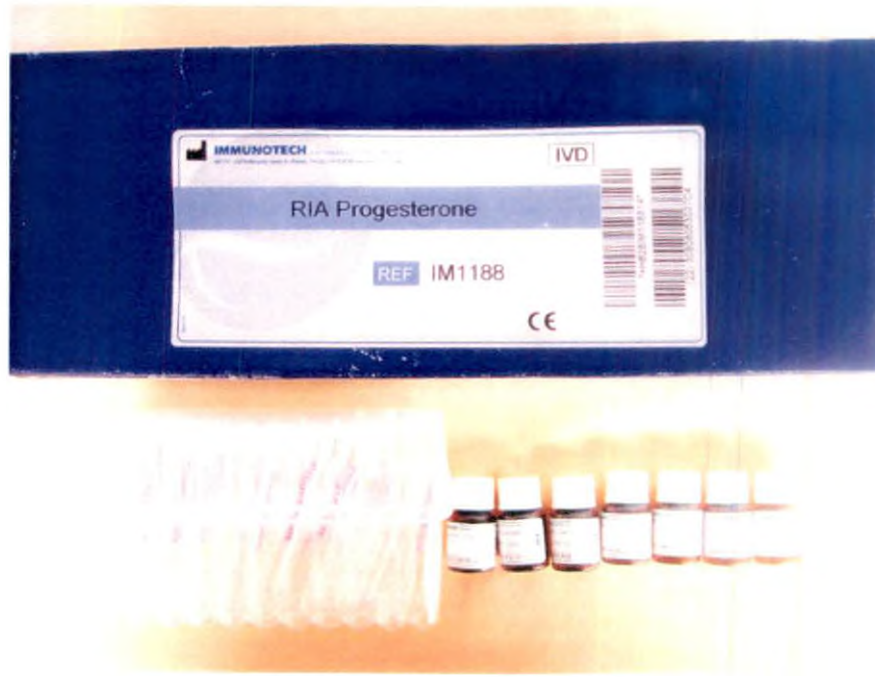


Plate.4. RIA Progesterone Assay Kit

Plate.5. Detection of does in oestrum by using vasectomised buck

Plate.6. Flehmen reaction exhibited by buck

Plate.7. Pregnancy diagnosis by abdominal palpation at three months

Results

4. RESULTS

The study was carried out to determine the effect of gonadotropin releasing hormone and prostaglandin for improving reproductive efficiency in goats.

Data was obtained to decipher the efficacy of various synchronization protocols for improving reproductive efficiency and estimation of the serum progesterone level was performed to assess the ovarian response to different synchronization protocols.

4.1 EFFECT OF GnRH ON FERTILITY

4.1.1 Duration of Oestrum

The duration of oestrum in Group IA and Group IB is presented in Table1. The mean duration of oestrum was found to be 19.33 ± 0.45 h in the GnRH treated group (Group IA) and the duration of oestrum ranged from 16 to 24 h. In the control group the mean duration of oestrum was 33 ± 0.58 h and the duration of oestrum ranged from 28 to 36 h. The duration of oestrum was significantly shorter in the GnRH treated group when compared to the control ($P<0.05$).

4.1.2 Serum Progesterone Level in Group IA and Group IB

The mean serum progesterone level in Group IA and Group IB on the day of oestrus was 0.43 ±0.05 ng/ ml and 0.40 ± 0.05 ng/ml respectively.

4.1.3 Conception Rate

Perusal of Table 4.and Figure 1 indicates that the conception rate in Group IA (GnRH treated group) and in Group IB (control group) was 50 per cent and 66.66 per cent respectively.

4.2 EFFECT OF CO-SYNCH PROTOCOL ON FERTILITY IN GROUP IIA

4.2.1 Oestrus Response

The oestrus response and oestrus onset interval in Group IIA is presented in Table 2. In Group IIA (CO-Synch protocol treated group) the oestrus response was found to be 90.9 per cent. Out of the twelve animals one doe failed to exhibit oestrus signs following administration of second dose of prostaglandin and failed to accomplish mating while another doe exhibited oestrus symptoms following the administration of first dose of GnRH, and hence was excluded from the protocol regime.

4.2.2 Oestrus Onset Interval

The oestrus onset interval following CO-Synch Protocol was found to be 47.6 ± 0.45 h. (Table 2.)

4.2.3 Intensity of Oestrum

The oestrus intensity score of induced oestrum ranged from 0 to 13. Percentage of animals that exhibited various oestrus signs in the induced oestrus in Group IIA is presented in Figure 2.

4.2.4 Duration of Oestrum

The mean duration of oestrum in the CO-Synch protocol was calculated as 24.5 ± 0.63 h which was significantly shorter than the mean duration of oestrum of 40 ± 0.91 h in Group IIC (control) (Table 3.).

4.2.5 Conception Rate

The conception rate was found to be 40 per cent (Table 4.and Figure 4.). In Group IIA (CO -Synch group) out of the 12 animals, 10 animals exhibited pronounced signs of oestrus on completion of treatment protocol out of which 4 animals conceived. one doe failed to exhibit oestrus signs following

administration of prostaglandin and hence breeding could not be accomplished, while another doe exhibited oestrus symptoms following the administration of first dose of GnRH, and hence was excluded from the protocol regime and this doe was was bred and it conceived.

4.2.6 Serum P_4 Level

The mean serum P_4 levels in Group IIA is represented in Figure 5. The mean serum P_4 levels of the pregnant does on day 0, 7 and 9 were 0.33 ± 0.09 ng/ml, 2.89 ± 0.25 ng/ml and 0.32 ± 0.047 ng/ml respectively, while the mean serum P_4 levels of the non pregnant does on days 0, 7 and 9 was 0.72 ± 0.22 ng/ml, 1.68 ± 0.39 ng/ml and 0.81 ± 0.21 ng/ml respectively. There was no significant difference between the pregnant and non pregnant does with respect to the serum progesterone levels ($P>0.05$). In one of the does in this group a short cycle of 11 days was observed following mating. The serum P_4 level in this doe had fallen to 1 ng/ml by day 11. In the doe that did not exhibit the oestrus signs following prostaglandin administration had serum P_4 level of 1.25 ng/ml on day 7 and following the prostaglandin injection the serum P_4 level on the 9^{th} day was stationed at 1.25 ng/ml. Out of the 7 does that did not conceive 3 does had serum progesterone level above 2 ng/ml at the time of prostaglandin administration and had exhibited pronounced oestrum and were bred but did not conceive.

4.3 EFFECT OF PROSTAGLANDIN PROTOCOL ON FERTILITY IN GROUP IIB

4.3.1 Oestrus Response

The oestrus response and oestrus onset interval in Group IIB is presented in Table 2. The oestrus response was 81.8 per cent. Out of the twelve animals in this group, two does did not exhibit oestrum after the administration of second dose of prostaglandin and failed to accomplish mating. One of the doe exhibited oestrum following the administration of first dose of prostaglandin and hence was excluded from the protocol regime.

4.3.2 Oestrus Onset Interval

The oestrus onset interval was found to be 54 ± 1.006 h (Table 2.).

4.3.3 Intensity of Oestrus

The oestrus intensity score of induced oestrum ranged from 0 to 13. Percentage of animals that exhibited various oestrus signs in the induced oestrus in Group IIB is presented in Figure 3.

4.3.4 Duration of Oestrus

The duration of oestrum was 39.77 ± 1.54 h, which was similar to the mean duration of oestrum of 40 ± 0.91 h in Group IIC (control) (Table 3.).

4.3.5 Conception Rate

The Conception rate in the prostaglandin protocol (Group IIB) was found to be 66.66 per cent against 33.33 per cent in control group (Table 4 and Figure 4.). In Group IIB out of the 12 animals, 9 animals exhibited pronounced signs of oestrus on completion of treatment protocol out of which 6 animals conceived. Two does failed to exhibit oestrus signs following administration of second dose ofprostaglandin and hence breeding could not be accomplished, while another doe exhibited oestrus symptoms following the administration of first dose of prostaglandin , and hence was excluded from the protocol regime and this doe was was bred and it conceived.

4.3.6 Serum P_4 level

The mean serum P_4 levels in Group IIB (Prostaglandin Group) is represented in Figure 6. The mean serum P_4 levels of the pregnant does on day 0, 11 and at 72 and 96 hours were 0.17 ± 0.07 ng/ml, 3.49 ± 0.49 ng/ml, 0.57 ± 0.09 ng/ml and 0.61 ± 0.09 ng/ml respectively. The mean serum P_4 level of the non pregnant does on day 0, 11 and at 72 and 96 h were 0.61 ± 0.1 ng/ml, 1.88 ± 0.70 ng/ml, 0.65 ± 0.31 ng/ml and 0.68 ± 0.32 ng/ml respectively. There was no

significant difference between the pregnant and non pregnant does with respect to the serum P_4 levels on days 0, 11 and at 72 and 96 h ($P>0.05$).

4.4 CORRELATION OF INTENSITY OF OESTRUS RESPONSE WITH SERUM P_4 LEVEL IN GOATS

The serum progesterone levels in goats exhibiting good and poor oestrous symptoms was analysed using RIA assay kit. The mean P_4 serum level in does exhibiting pronounced oestrum was 0.40 ± 0.05 ng/ml, while the mean serum progesterone level in goats exhibiting poor oestrus symptoms was 0.67 ± 0.07 ng/ml. There was non significant different between the two groups in the level of serum progesterone level ($P>0.05$).

4.5 ACCURACY OF PREGNANCY DIAGNOSIS

Three does in the Group IA (50 per cent) and four does in the Group IB (66.66 per cent) were diagnosed as pregnant.Six does in the Group IIA (60 per cent), seven does in the Group IIB (77.77 per cent) and two does in the group IIC (33.33 per cent) were diagnosed as pregnant. The results obtained were compared with the number of does kidded and the accuracy of the method was found to be 90 per cent.

4.6 GESTATION LENGTH IN GOATS

Average gestation length in the does in different experimental groups is presented in Table 5. Average gestation length in the does was 146. 034 ± 0.76 days. Mean gestation length in Group IA, IB, IIA, IIB and IIC were 144.67 ± 0.23 days, 144.5 ± 0.97 days, 146.00 ± 0.71 days, 145.5 ± 0.31 days and 148.5 ± 3.17 days respectively.

4.7 LITTER SIZE

In Group IA, there were three births and all of them were twins.Out of the 6 kids born, 5 (83.3 per cent) were males and 1 (16.6 per cent) was female. The litter size was found to be 2.

In Group IB, 1 doe (25 per cent) gave birth to triplet, 2 does to twins (50 per cent) and 1 doe to single kid (25 per cent) .Out of the 8 kids born, 4 were males (50 per cent) and 4 were females (50 per cent). Mean litter size at birth was 2.

In Group IIA, were four births and all of them were twins. Total kids born were 8, out of which 5 (62.5 per cent) were females and 3 were males (37.5 per cent). Mean litter size at birth was 2.

In Group IIB, 1 doe gave birth to triplet (16.6 per cent), 3 does gave birth to twins (50 per cent) and two does gave birth to single kids (33.33 per cent).Total kids born were 11, of which 7 (63.63 per cent) were males and 4 were females (36.36 per cent). Mean litter size at birth was 1.83.

In Group IIC, 2 does gave birth to twins. Total kids born were 4, of which 1 was a male (25 per cent) and 3 were females (75 per cent). Mean litter size at birth was 2.

Out of the total 19 pregnant animals, 2 does (10.52 per cent) gave birth to triplets, 14 does (73.68 per cent) gave birth to twins and 3 does (15.78 per cent) gave birth to single kids. In total 37 kids were born of which 22 were males and 15 females. Percentage of male and female kids in the total number of kids born was 59.45 per cent and 40.54 per cent respectively (Table 6. and Figure 7.)

4.8 BIRTH WEIGHT OF KIDS

Average birth weight of kids was 2.35 ± 0.164 kg. Mean birth weight of male kids was 2.42 ± 0.98 kg and that of female kids was 2.28 ± 0.36 kg. The average birth weight of kids in Group IA, IB IIA ,IIB and IIC were 2.43 ± 0.01, 2.02 ± 0.009, 2.29± 1.02 , 2.12 ± 0.60 and 2.01 ± 0.08 respectively (Table 5 and Figure 8.)

Table 1. Duration of oestrus in Group IA (GnRH treated group) and Group IB (Control group)

Group	Duration of oestrus (h)	Mean duration of oestrus (h)	P value
Group IA	16-24	$19.3^{a} \pm 0.45$	0.00002
Group IB	28-36	$33^{b} \pm 0.58$	

a,b –Means with different superscripts differ significantly($P<0.05$).

Table 2. Oestrus response and oestrus onset interval in Group IIA(CO-Synch treated group) and Group IIB (Double PGF2α treated group)

Group	Number of animals treated	Number of animals out of protocol	Number of animals remaining in the protocol	Number of animals exhibited oestrus post PGF2α administration	Oestrus response (%)	Oestrus onset interval (h)	P value
Group IIA	12	1	11	10	90.9	$47.6^{a} \pm 0.45$	0.005
Group IIB	12	1	11	9	81.8	$54^{b} \pm 1.006^{b}$	

a,b –Means with different superscripts differ significantly($P<0.05$).

Table 3. Duration of estrum in Group IIA , Group IIB and Group IIC

Group	Duration of oestrus (h)	Mean duration of oestrus (h)	P value
Group IIA	16 - 25	$24.5^{a} \pm 0.63$	0.006
Group IIB	20 -48	$39.77^{b} \pm 1.54$	
Group IIC	24- 48	$40^{b} \pm 0.91$	

a,b- Different superscripts indicate significant difference between the groups ($P<0.05$).

Table 4. Conception rate in the different experimental groups

Group	Number of animals treated	Number of animals out of protocol	Number of animals exhibited oestrum and mated	Number of Animals conceived	Conception rate in animals that exhibited oestrum(%)
Group IA	6	-	6	3	50
Group IB	6	-	6	4	66.66
Group IIA	12	1	10	4	40
Group IIB	12	1	9	6	66.66
Group IIC	6	-	6	2	33.33

Table 5. Gestation length and average birth weight of kids in the different experimental groups

Group	Gestation length (days)	Average birth weight (kg)
Group IA	144.67 ± 0.23	2.43 ± 0.01
Group IB	144.5 ± 0.97	2.02 ± 0.009
Group IIA	146.00 ± 0.71	2.29 ± 1.02
Group IIB	145.5 ± 0.31	2.12 ± 0.60
Group IIC	148.5 ± 3.17	2.01 ± 0.08

Table 6. Incidence of multiple births

Group	Total kiddings observed	Singleton	Twins	Triplets
Group IA	3		3	
Group IB	4	1	2	1
Group IIA	4		4	
Group IIB	6	2	3	1
Group IIC	2		2	
Total	19	3	14	2

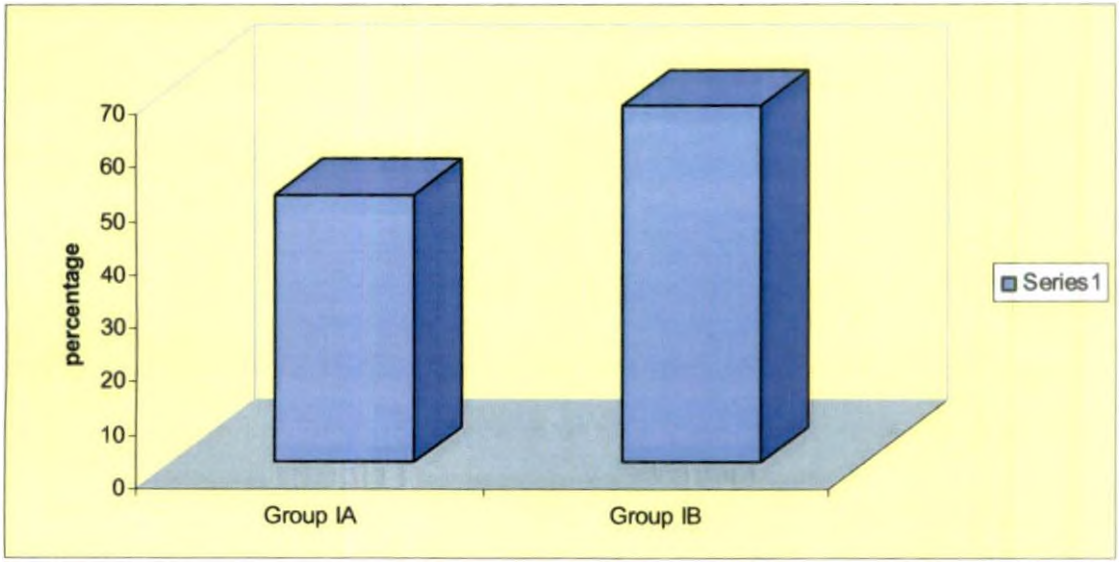


Fig.1.Conception Rate,(%) in Group IA (GnRH treated) and Group IB animals (Control)

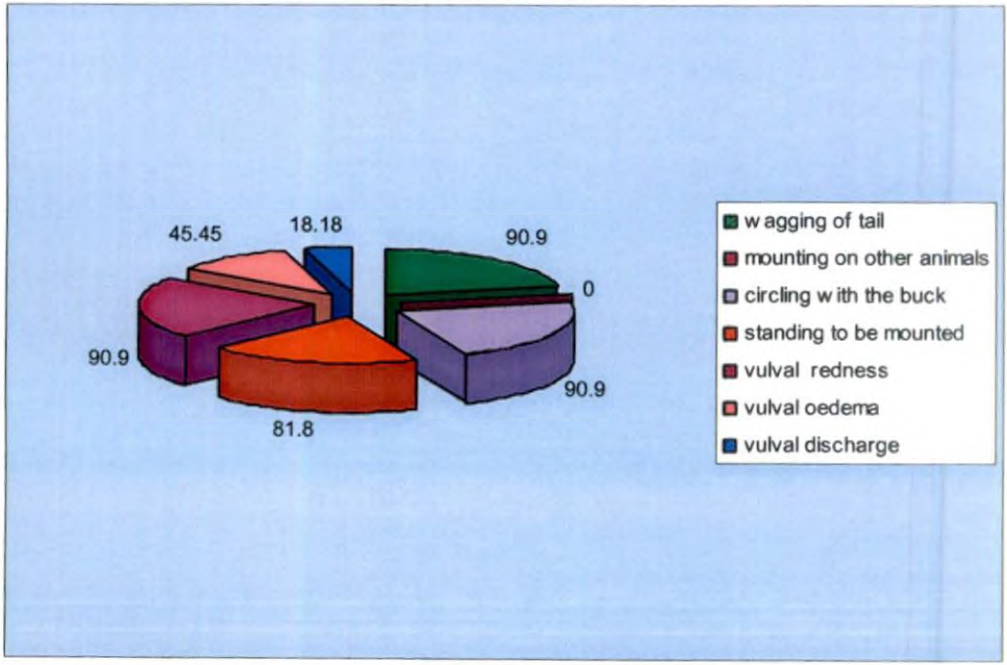


Fig.2. Incidence of Oestrus Signs in Group II A

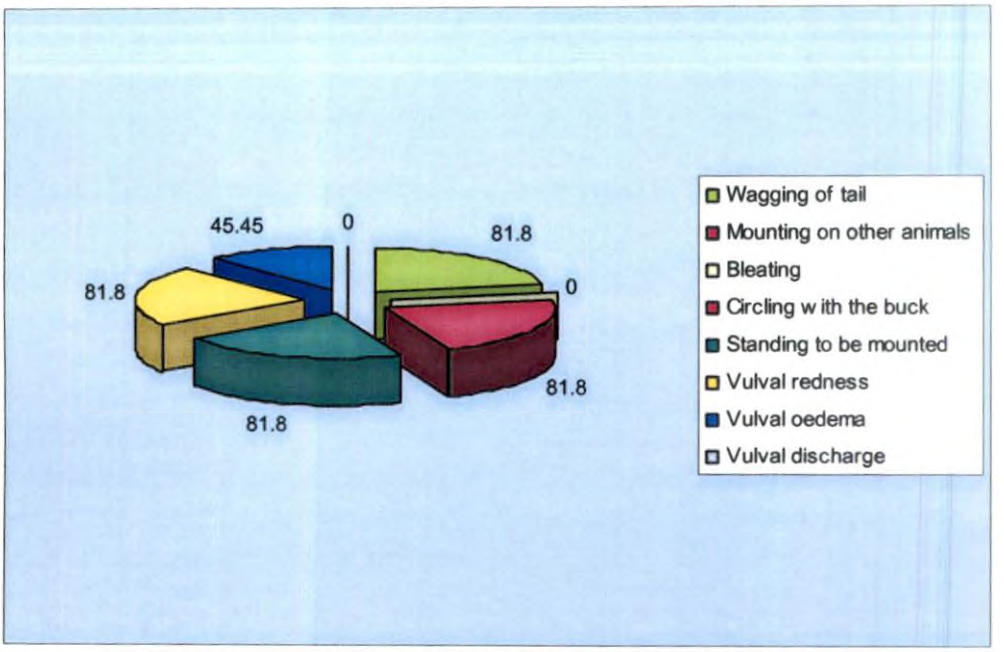


Fig.3. Incidence of Oestrus Signs in Group II B

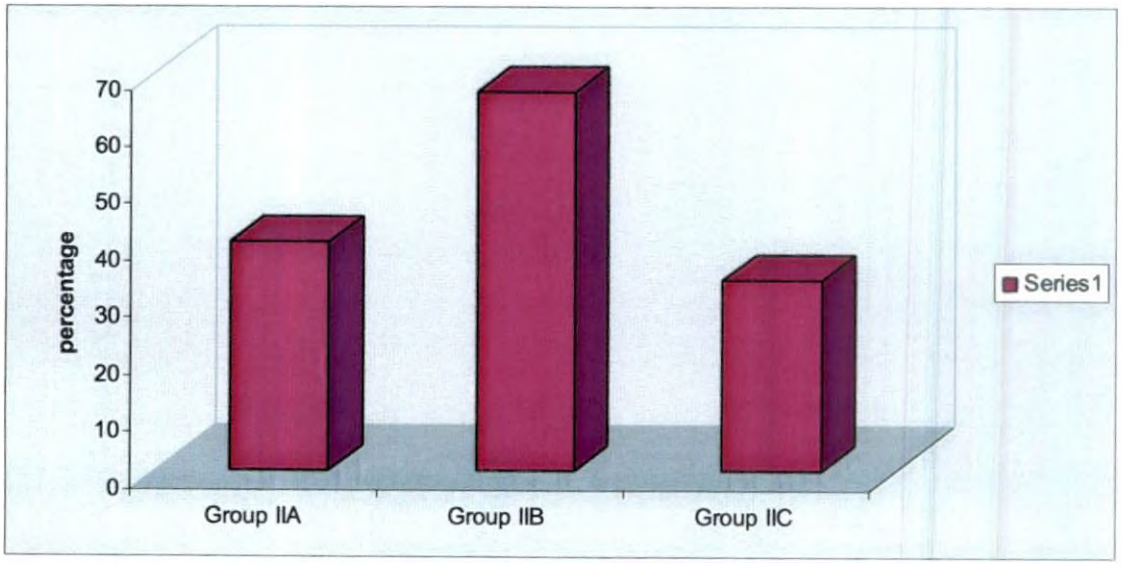


Fig.4. Conception Rate,(%) in Group IIA, Group IIB and Group IIC animals

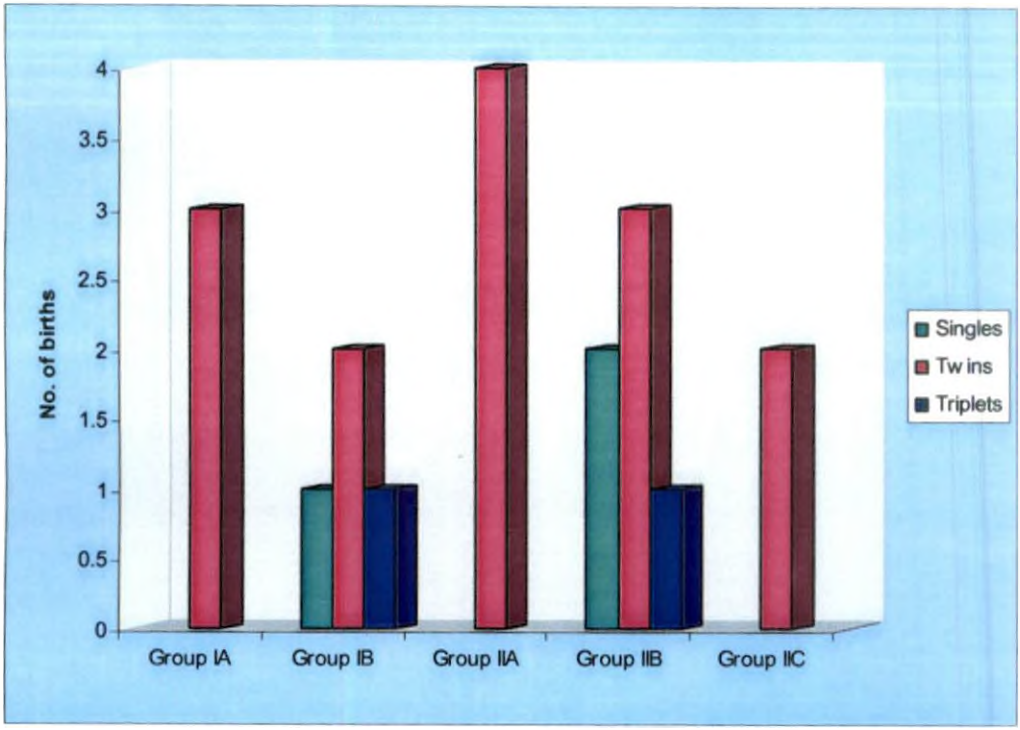


Fig.7. Incidence of multiple births

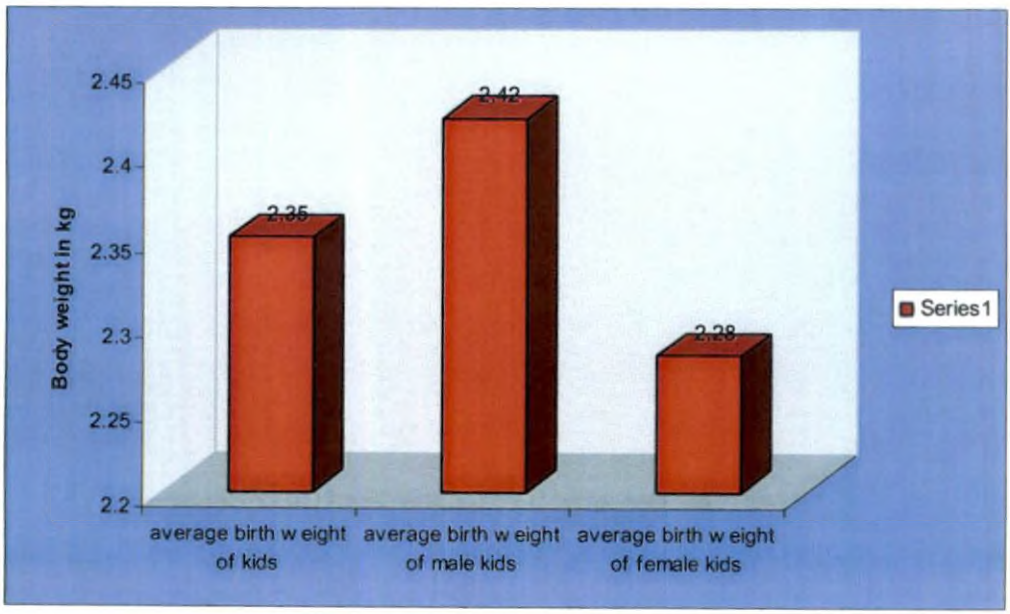


Fig.8.Birth Weight of Kids

Plate 8. Doe with its litter

Discussion

5. DISCUSSION

5.1 RESPONSE TO GnRH ADMINISTRATION IN GOATS EXHIBITING PRONOUNCED OESTRUS

5.1.1 Duration of Oestrum

The mean duration of oestrum in Group IA and Group IB is presented in Table 1. The mean duration of oestrum following GnRH administration was 19.33 ± 0.45 hours and the duration of oestrum ranged from 16-24 h, while in the control group the mean duration of oestrum was 33 ± 0.58 h and the duration of oestrum ranged from 28-36 h. There was a significant difference in the GnRH treated group (Group IA) and Group IB (control) with respect to the mean duration of oestrum. This result is in agreement with that obtained by Ghosh (1998) in does and Singh and Madan (1985) in ewes who reported the mean oestrus duration following GnRH administration as 18.0 ± 4.243 h and 20.50 ± 1.527 h respectively.

It could be concluded that administration of GnRH induced an early pre-ovulatory LH surge that induced ovulation resulting in a shorter duration of oestrus.

5.1.2 Serum Progesterone Level

The serum P_4 level on the day of oestrum in Group IA and IB was 0.43 ± 0.05 ng/ml and 0.40 ± 0.05 ng/ml respectively which was non significantly different from one another($P>0.05$). This is similar to the serum P_4 level reported by Baruah *et al.* (1987) and Pathak *et al.*(1990) during oestrus in goats.

5.1.3 Fertility following GnRH Administration

The conception rate in Group IA and Group IIB is presented in Table 4 and Figure 1. The conception rate in Group IA (GnRH treated group) was 50 per

cent, while in Group IB (Control group) it was 66.66 per cent. The conception rate obtained in this study in the GnRH treated group was less than that reported by Singh and Madan (1985) in ewes , similar to that reported by Mandal *et al.* (2004) in buffaloes, and higher than those reported by Mee *et al.* (1996) in cattle. The conception rates obtained in these three studies were 66 per cent, 50 per cent and 35 per cent respectively. Different workers have suggested various reasons for reduced fertility in GnRH treated animals. According to Singh and Madan (1985) GnRH induces precocious ovulation during follicular phase of the oestrus cycle, that curtails time required for the potentiation of all ovulatory mechanisms during pre-ovulatory phase resulting in possible immature egg production, poor fertilizing ability, and thus low conception rate. Perry *et al.* (2002) opined that ovulation of smaller follicles using GnRH did not effect subsequent CL formation and progesterone secretion, but might lead to increased embryonic death. Thus, in the present study reduced conception rate obtained in the GnRH treated does when compared to the control may be attributed to precocious ovulation of dominant follicle.

However, contrary to these findings Mandal *et al.* (2004) and Ullah *et al.* (1996) opined that GnRH administration at oestrus improved conception rate by potentiating the conversion of small luteal cells to large luteal cells resulting in the formation of large sized functional CL with enhanced progesterone secretion which was required for embryo survival.

5.2 RESPONSE TO CO-SYNCH PROTOCOL

The CO-Synch protocol was adopted in this study as breeding or insemination can be carried out following administration of second dose of GnRH on day 9 which is more convenient to the animal owner as against the Ovsynch protocol where breeding is carried out 12 -18 h after the second dose of GnRH.

5.2.1 Oestrus Response

The oestrus response in Group IIA (CO-Synch group) was 90.9 per cent (Table 2). This agrees with Beck *et al.* (1996) who obtained similar result in synchronization protocols using combination of Buserelin and $PGF_2\alpha$ in ewes. The result is slightly less than that reported by Ataman and Akoz (2006) in ewes who reported the oestrus response as 93.3 per cent.

5.2.2 Oestrus Onset Interval

The oestrus onset interval following the administration of prostaglandin was 47.6 ± 0.45 h (Table 2.). This is in agreement with that reported by Ataman and Akoz (2006) in ewes.

5.2.3 Intensity of Oestrus

Percentage of animals that exhibited various oestrus signs in induced oestrum in Group IIA (CO-Synch protocol group) is given in Figure 2. Oestrus intensity scores of the does following the prostaglandin administration ranged from 0 to 13. The oestrus signs observed in the does in the induced oestrum were wagging of tail (90.9 per cent), circling (90.9 per cent), and standing to be mounted (81.8 per cent), vulval hyperaemia (90.9 per cent), vulval oedema (45.45 per cent) and vulval discharge (18.18 per cent). Bleating was not exhibited by any of the does which is contrary to the findings of Smith (1980), Shivkumar (1993) and Noakes *et al.* (2001) in goats.

5.2.4 Duration of Oestrum

The duration of oestrum in the CO-Synch protocol was 24.5 ± 0.63 h, which is similar to the result reported by Twagiramungu *et al.* (1995) and Pursley (2007) in dairy cattle. The duration of oestrum was significantly shorter than that obtained in the control which was of 40 ± 0.91 h ($P>0.05$) (Table 3).

5.2.5 Conception Rate

The conception rate obtained in the various experimental groups is given in Table 4 and Figure 4.The pregnancy rate was 40 per cent against 33.33 per cent in control group. This result was much less than those reported by Beck *et al.* (1996) and Ataman and Akoz (2006) in ewes and by Pursley *et al.* (1995) in dairy cattle. They reported the conception rate as 88.8 per cent and 85.7 per cent and 50 per cent respectively This result is higher than that reported by Lemaster *et al.* (2001) using CO-Synch protocol in cattle, Paul and Prakash (2005) using Ovsynch in buffaloes and Lean *et al.* (2003) in dairy cattle. The conception rates reported by them were 35.5 per cent, 33.3 per cent and 37.6 per cent respectively. The doe which was excluded from the protocol regime on exhibition of oestrum following the first dose of GnRH was mated and it conceived. It can be presumed that the primary dose of GnRH in this animal might have resulted in follicular atresia and lead to development of another follicular wave, later follicular maturation and ovulation finally resulting in conception.

5.2.6 Serum Progesterone Level and Fertility

The mean serum P_4 levels in Group IIA is given in Figure 5. In Group IIA (CO-Synch group) the mean serum P_4 level on day 0, 7 and 9 was 0.58 ± 0.154 ng/ml, 2.12 ± 0.63 ng/ml and 0.63 ± 0.15 ng/ml respectively. In all four does became pregnant while seven does were non pregnant. The mean serum P_4 levels of the pregnant does on day 0, 7 and 9 was 0.33 ± 0.09 ng/ml, 2.89 ± 0.25 ng/ml and 0.32 ± 0.047 ng/ml respectively, while the mean serum progesterone levels of the non pregnant does on day 0, 7 and 9 was 0.72 ± 0.22 ng/ml;, 1.68 ± 0.39 ng/ml and 0.81 ± 0.21 ng/ml respectively. Eventhough there was non significant difference in the progesterone concentrations between animals that were pregnant and non pregnant ($P>0.05$), the P_4 level before $PGF_2\alpha$ administration on seventh day was higher in those animals that became pregnant subsequently.

Post prostaglandin administration the P_4 level in these animals dropped to basal values of 0.32± 0.047 ng/ml and thus had minimum P_4 level on the day of mating. This is in agreement with that reported by Husein *et al.* (2005) in goats who opined that greater P_4 concentration on the day of AI decreased the likelihood of pregnancy. Two goats in the non-pregnant category had elevated P_4 level on day 7, and post $PGF_2\alpha$ administration the progesterone value decreased to basal levels followed by exhibition of pronounced oestrus signs. These animals were then administered a second dose of GnRH on the ninth day as per the CO-Synch protocol and bred, nevertheless they did not conceive. Similar findings were reported by Mawhinney *et al.* (1996) and Peters *et al.* (2003) in cows treated under Ovsynch protocol and they opined that low conception rates may be attributed to the second dose of GnRH which causes an early ovulation of the dominant follicle when fertility of the oocyte has not reached maximum potential resulting in increased embryonic death.

One of the does exhibited oestrus signs on the 11th day following mating. The serum P_4 level in this doe had fallen below 1 ng/ml by day 11. This agrees with Saharrea *et al.* (1998) who opined that premature luteal regression in goats can be considered to have occurred if progesterone level declined to less than 1 ng/ml by day 6. Only one animal in this study failed to exhibit oestrus signs following administration of prostaglandin. The serum P_4 level in this doe indicated that there was no luteal regression in response to the prostaglandin injection. Similar findings were reported by Pursley *et al.* (1995) in dairy cattle and they opined that administration of $PGF_2\alpha$ at an early unresponsive stage of luteal development failed to cause luteal regression and hence, absence of exhibition of oestrum. In three does the progesterone level was below 1 ng/ml on day 7 at the time of administration of prostaglandin. This may be due to spontaneous luteolysis and regression of the corpus luteum between administration of the first dose of GnRH and $PGF_2\alpha$ (Lean *et al.*, 2003 and Pursley and Bello, 2007).

One of the doe exhibited oestrus following administration of first dose of GnRH, this doe was bred and was excluded from the protocol regime. Similar findings were reported by Husein *et al.* (2005) who opined that the first GnRH injection might have resulted in follicular atresia and therefore reset the follicular wave. Emergence of a new follicular wave after GnRH injection may have led to the development of a large follicle capable of producing sufficient estradiol that caused oestrus signs.

5.3 RESPONSE TO PROSTAGLANDIN PROTOCOL

5.3.1 Oestrus Response

The oestrus response was 81.8 per cent in goats (Table 2.) Cent per cent oestrus response was reported in goats following estrous synchronization using double $PGF_2\alpha$ protocol by Pandey *et al.* (1985), Kutty and Mathew (1996), Wildeus (1999) and Bharali and Dutta (2001). The result was higher than those reported by Chede *et al.* (2002) and Uphale (1998) in goats who reported the oestrus response as 63.40 per cent and 50 per cent. However the result obtained in this study which was less than those reported by Beck *et al.* (1996) and Ataman and Akoz (2006) in ewes who reported the oestrus response following double $PGF_2\alpha$ as 94 per cent and 86.6 per cent respectively.

5.3.2 Oestrus Onset Interval

In the present study, the average time taken for the onset of oestrus in does after the administration of second dose of $PGF_2\alpha$ was 54 ± 1.006 h (Table 2). This result was in consonance with the earlier findings of Amoah and Gelaye (1990), Chede *et al.* (2002) in goats and Ataman and Akoz (2006) in ewes.The interval for onset of oestrus was shorter in the findings of Wildeus (1999) and Afsal (2003) in goats. Wildeus (1999) opined that the time required for onset of oestrus was reduced by the continuous exposure of does to bucks following synchronization regimen using cloprostenol in Nubian goats. . Bucks

kept away from the prostaglandin treated does except during the heat detection periods might have prolonged the time for onset of oestrus in the present study.

5.3.3 Intensity of Oestrus

Percentage of animals that exhibited various oestrus signs in induced oestrum in Group IIB (prostaglandin protocol group) is given in Figure 3. Oestrus intensity scores of the does following the prostaglandin administration ranged from 0 to 13. The oestrus signs observed in the does in the induced oestrum were wagging of tail (81.8 per cent) circling around buck (81.8 per cent), standing to be mounted (81.8 per cent), vulval hyperaemia (81.8 per cent), vulval oedema (45.45 per cent) and vulval discharge (zero per cent) Bleating and mounting on other animals were not exhibited by any doe. This is contrary to the findings of Goel and Agrawal (1994) and Senthilkumar (2002) who reported frequent bleating as one of the salient signs of oestrus in goats.

5.3.4 Duration of Oestrum

The mean duration of oestrum in does in prostaglandin induced oestrus was 39.77 ± 1.54 h with a range of 20 to 48 h (Table 3.). This result is similar to that reported by Romano (1998) higher than those reported by Goel and Agrawal (2000), Bharali and Dutta (2001) and Chede *et al.* (2002) in goats. The mean duration of oestrum was similar to that obtained in the control which was of 40 ± 0.91 h.

5.3.5 Conception Rate

The conception rate obtained in the double $PGF_2\alpha$ protocol in this study was 66.66 per cent against 33.33 per cent in control group (Table 4. and Figure 4.) The result was similar to that reported by Kusina *et al.* (2000) in goats. Higher than those reported by Noakes *et al.* (2001), Chede *et al.* (2002), Gade *et al.* (2003) in goats and by Lean *et al.* (2003) in cows and lower than those reported by Singh *et al.* (1985), Amoah and Gelaye (1990), Singh *et al.* (2005) in

goats and by Ataman and Akoz (2006) in ewes. One of the does which exhibited oestrum after the first dose of prostaglandin was bred and it conceived to first service

5.3.6 Serum Progesterone Level and Fertility

The mean serum P_4 levels in Group IIA is given in Figure 6. In the Group IIB (double $PGF_2\alpha$ group) the mean serum P_4 levels on days 0, 11 and during timed matings at 72 and 96 h were 0.68 ± 0.06 ng/ml, 2.76 ± 0.46 ng/ml, 0.74 ± 0.156 ng/ml and 0.79 ± 0.16 ng/ml respectively.

The mean serum P_4 levels of the pregnant does on day 0, 11 and at 72 and 96 h were 0.17 ± 0.07 ng/ml, 3.49 ± 0.49 ng/ml, 0.57 ± 0.09 ng/ml and 0.61 ± 0.09 ng/ml respectively. The mean serum progesterone level of the non-pregnant does on day 0, 11, and at 72 and 96 h was 0.61 ± 0.1 ng/ml, 1.88 ± 0.70 ng/ml, 0.65 ± 0.31 ng/ml and 0.68 ± 0.32 ng/ml respectively. Eventhough there was no significant difference between the pregnant and non pregnant does with respect to the serum P_4 level on day 0, 11 and at 72 and 96 h ($P>0.05$), six pregnant goats had an elevated serum P_4 concentration on day 11, on the day of administration of prostaglandin. Post $PGF_2\alpha$ administration the P_4 level dropped to the basal value and the goats exhibited oestrum and were bred. Thus, these goats had minimum P_4 level on the day of mating which is in agreement with that reported by Lopes *et al.* (2006) in cows who opined that a greater P_4 concentration on the day of AI decreased the likelihood of pregnancy.

Two of the does failed to exhibit oestrum following the second dose of prostaglandin and had a mean serum P_4 level above 1 ng/ml post $PGF_2\alpha$ administration. The failure to exhibit oestrus may be attributed to late luteolysis, late formation of the corpus luteum or to incomplete luteal regression after the first $PGF_2\alpha$ injection (Jemmeson, 2000 and Ataman and Akoz, 2006).

Three of the does exhibited oestrus within a few days after mating, this may be attributed to premature luteal regression (Ghosh, 1998).

One of the does which exhibited oestrum after the first dose of prostaglandin was bred and it conceived to first service. Similar findings were reported by Romano (1998) in goats who attributed it to short cycles which are common in prostaglandin based protocols.

5.4 VARIATION IN THE EXPRESSION OF OESTRUS SYMPTOMS

In goats similar to other livestock species sexual receptivity of the female for the male is limited to a short period referred to as 'oestrus'. The present study was undertaken in to find out the fertility variation in goats exhibiting pronounced oestrus symptoms compared to those that exhibited oestrus of weak intensity. Variations in the expression of oestrus symptoms can be attributed to various reasons.

According to Singh and Madan (1985) production, secretion and action of hormone oestradiol is essential for triggering and expressing sexual behaviour and that poor expressivity of behavioural oestrus in goats may be attributed to the lack of optimum concentration of estrogen which could be due to poor follicular growth. Chandra *et al.*(2006) found that ambient temperature does play a major role in the expression of oestrus and opined that exhibition of mild signs of oestrum in heat-exposed animals were due to lower levels of circulating oestradiol.

According to Goel and Agarwal (2002) behavioural oestrus symptoms in goats varied among breed and individuals in different physiological status. They reported that in Jakhrana breed, pubertal goats and does at first post partum oestrus exhibited oestrus symptoms of moderate and weak intensity respectively while adult goats, both nulliparous and parous exhibited typical oestrus symptoms with the oestrus being more intense in parous goats. The serum progesterone level in goats exhibiting pronounced and weak estrus symptoms were 0.40 ± 0.05 ng/ml and 0.67 ± 0.07 ng/ml respectively this is similar to the serum progesterone level reported by Baruah *et al.*(1987) and Pathak *et al.*(1990)

during oestrus in goats. Eventhough significant difference could not be observed between the two groups in serum progesterone level on the day of oestrum a moderately high level of progesterone seen in Group II may be responsible for exhibition of poor behavioural oestrus signs.

5.5 ACCURACY OF PREGNANCY DIAGNOSIS

Twenty two goats were diagnosed pregnant by abdominal palpation at three months of gestation. The results obtained at kidding showed that only 19 goats were pregnant. The accuracy of the abdominal palpation method for pregnancy diagnosis was 90.9 per cent. According to Goel and Agrawal (1990) accuracy of abdominal palpation in goats for pregnancy diagnosis was 90.3 per cent at 71-80 days and 95.38 per cent at 80 days and later.

5.6 GESTATION LENGTH IN GOATS

Average gestation length in the does was 146.03 ± 0.76 days. Mean gestation length in animals that conceived in Group IA, IB, IIA, IIB and IIC was 144.67 ± 0.23 days, 145.5 ± 0.97 days, 146 ± 0.71 days, 145.5 ± 0.31 days and 148.5 ± 3.17 days respectively (Table 5.). This is similar to the findings reported by Kuriakose (1981), Prasanth (1995) in Malabari crossbred does. This is similar to the findings reported by Bhooshan and Kumar (2007) and Smith (2007) in other breeds of goats.

5.7 LITTER SIZE

The litter size at birth in Group IA, Group IB, Group IIA, IIB and IIC were 2, 2, 2, 1.83 and 2 respectively. The litter size of 2 and 1.83 obtained in Group IIA (CO-Synch group) and Group IIB (prostaglandin group) was higher than that reported by Ataman and Akoz (2006) in ewes. They reported the litter size as 1.7 and 1.66 for GnRH-$PGF_2\alpha$ and $PGF_2\alpha$-$PGF_2\alpha$ protocols respectively. The incidence of triplets, twins and single kids were in the present study were 10.52, 73.68 and 15.78 per cent respectively (Table 6 and Figure 7). The

incidence of twins in this study was higher than those reported by Prasanth (1995) and less than those reported by Afsal (2003) in similar studies carried out in goats in the same goat farm.

5.8 BIRTH WEIGHT OF KIDS

Average birth weight of kids was 2.35 ± 0.164 kg. This is similar to the findings of Afsal (2003) but slighty varying from those reported by Prasanth (1995). The mean birth weight of male and female kids was 2.42 ± 0.98 kg and 2.28 ± 0.36 kg respectively (Figure 8.).

5.9 EFFECT OF HORMONE ON LITTER SIZE AND BIRTH WEIGHT

The average birth weight of kids was 2.35 ± 0.164 kg and the average gestation length was 146.03 ± 0.76 days. In the present study it was observed that GnRH and $PGF_2\alpha$ administration has not influenced the gestation length and birth weight of kids. This is similar to the findings reported by Shivkumar (1993) who reported that average birth weight of kids born to synchronized and control does were not significantly different at 5 per cent level. Similar findings were reported by Yang Shenglin *et al.* (1999) and Zarkawi (2000) in goats.

Summary

6. SUMMARY

The present study was carried out to determine the effect of GnRH and prostaglandin for improving reproductive efficiency in goats. A total of 42 cycling crossbred Malabari does maintained under ideal managemental conditions at University Sheep and Goat Farm, Kerala Agricultural University, Mannuthy, Thrissur were used for the study. In does exhibiting oestrum, the oestrus associated behavioural signs and physiological changes were observed and based on these observations the animals were grouped into viz., Group I comprising of animals exhibiting pronounced oestrus and Group II comprising of animals exhibiting weak oestrus.

The animals in Group I were divided into two subgroups namely Group IA and Group IB each comprising six animals. Group IA animals were administered an intramuscular injection of 0.0042 mg of Buserelin (1 ml Receptal) and then bred and Group IB served as the control. Blood was collected from all does prior to GnRH administration and breeding for serum progesterone analysis. The mean duration of oestrum in Group IA was 19.33 ± 0.45 h which was significantly shorter than the mean duration of oestrum of 33 ± 0.58 h in Group IB (control). The duration of oestrum in Group IA and Group IB were in the range of 16-24 h and 28-36 h respectively. The progesterone level on the day of oestrum in Group IA and IB was 0.43 ± 0.05 ng/ml and 0.40 ± 0.05 ng/ml which was not significantly different from one another($P>0.05$) The conception rate in Group IA and Group IB was 50 per cent and 66.66 per cent respectively. Thus, it can be inferred that administration of GnRH on the day of oestrum in animals exhibiting pronounced oestrus signs failed to improve conception rate.

The animals in Group II were divided into three subgroups namely Group IIA, IIB and IIC. Group IIA animals were treated as per the CO-Synch protocol (i/m inj. of 0.0042 mg of Buserelin (1 ml Receptal) on day 0, 125 µg cloprostenol (0.5 ml clostenol) on day 7; 0.0042 mg of Buserelin and mating on day 9).

Blood was collected for serum $P_{4\ analysis}$ before treatment administration on day 0, 7 and 9. The oestrus response in Group IIA (CO-Synch protocol) was 90.9 per cent. The oestrus onset interval was 47.6 ± 0.45 h. The mean duration of oestrum was 24.5 ± 0.65 h which was significantly shorter than the mean duration of oestrum in Group IIC (Control). The conception rate was 40 per cent. The serum P_4 levels of the pregnant does on day 0, 7 and 9 were 0.33 ± 0.09 ng/ml, 2.89 ± 0.25 ng/ml and 0.32 ± 0.047 ng/ml respectively, while the mean serum P_4 levels of the non pregnant does on day 0, 7 and 9 were 0.72 ± 0.22 ng/ml, 1.68 ± 0.39 ng/ml and 0.81 ± 0.21 ng/ml respectively. There was non significant difference in the P_4 concentrations between does that were pregnant and non pregnant ($P>0.05$). Follicular atresia, spontaneous luteolysis and premature luteal regression could be the reasons for the failure of goats to conceive.

Group IIB were treated as per prostaglandin protocol which comprised of two intramuscular injections of 125 µg cloprostenol (0.5 ml clostenol) 11 days apart followed by breeding at 72 and 96 h. Blood was collected for serum P_4 level analysis on days 0, 11, and at 72 and 96 h prior to prostaglandin administration and breeding. The oestrus response in Group IIB was 81.8 per cent. Oestrus onset interval was 54 ± 1.006 h and the mean duration of oestrum was 39.77 ± 1.54 h which was similar to the mean duration of 40 ± 0.91 h in the Group IIC (control). The pregnancy rate was 66.66 per cent. The serum P_4 level of the pregnant does on day 0, 11, and at 72 and 96 h were 0.17 ± 0.07 ng/ml, 3.49 ± 0.49 ng/ml, 0.57 ± 0.009 ng/ml and 0.61 ± 0.09 ng/ml respectively. The mean serum P_4 levels of the non pregnant does on day 0, 11 and at 72 and 96 h were not significantly different from that of pregnant animals($P>0.05$). Failure of luteolysis, occurrence of short cycles and premature luteal regression could be the reasons for the failure of goats to conceive.

Hence, the conception rate in Group IA, IB, IIA, IIB and IIC was 50 per cent, 66.66 per cent, 40 per cent, 66.66 per cent and 33.33 per cent respectively.

Pregnancy diagnosis was performed by abdominal palpation at three months of gestation and the accuracy of the method was found to be 90.9 per cent. Average gestation length in the does was 146.03 ± 0.76 days. There was no significant difference in the different experimental groups with respect to gestation length. Mean litter size at birth in Group IA, IB, IIA, IIB and IIC were 2, 2, 2, 1.83 and 2 respectively. Average birth weight of kids was 2.35 ± 0.164 kg. The mean birth weight of male and female kids was 2.42 ± 0.98 kg and 2.28 ± 0.36 kg respectively.

Thus from the present study, it can be concluded that :-

1. Administration of GnRH on the day of oestrum in animals exhibiting pronounced oestrus signs failed to improve conception rate when compared to the control.

2. In animals exhibiting weak oestrus signs both CO-Synch and double prostaglandin protocols resulted in higher conception rate when compared to control group.

3. The double prostaglandin protocol was found to be more efficient in improving conception rate in animals exhibiting weak oestrus signs.

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EFFECT OF GONADOTROPIN RELEASING HORMONE AND PROSTAGLANDIN FOR IMPROVING REPRODUCTIVE EFFICIENCY IN GOATS

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ABSTRACT

With the objective of studying the effect of GnRH and prostaglandin for improving reproductive efficiency in goats the study was carried out at University Sheep and Goat Farm, Mannuthy using 42 cycling goats. Based on the behavioural and physiological changes associated with oestrum the goats were divided into two groups viz., Group I and Group II. Group I animals were those that exhibited pronounced oestrus signs and were divided into two subgroups namely Group IA and Group IB. Group II animals were those that exhibited weak oestrus signs and were divided into three subgroups namely Group IIA, IIB and IIC.

Group IA animals were administered 0.0042 mg Buserelin (1 ml Receptal) a potent GnRH analogue on day 0, and Group IB served as the Control. Blood was collected prior to GnRH administration and breeding from all does. The mean duration of oestrum in Group IA and IB was 19.33 ± 0.45 and 33 ± 0.58 h respectively. The conception rate in Group IA and IB was 50 per cent and 66.66 per cent respectively. The serum P_4 level on day 0 in does in Group IA and IB was 0.43 ± 0.05 ng/ml and 0.40 ± 0.05 ng/ml respectively.

Group IIA and Group IIB does were treated as per the CO-Synch protocol (i/m inj. of 0.0042 mg of Buserelin (1 ml Receptal) on day 0, 125 µg cloprostenol (0.5 ml clostenol) on day 7; 0.0042 mg of Buserelin and mating on day 9) and prostaglandin protocol respectively (two intramuscular injections of 125 µg cloprostenol (0.5 ml clostenol) 11 days apart followed by mating at 72 and 96 h), while Group IIC served as the control. The oestrus response, oestrus onset interval, duration of oestrum and conception rate in Group IIA was 90.9 per cent, 47.6 ± 0.45 h, 24.5 ± 0.63 h and 40 per cent respectively. The oestrus intensity score of induced oestrus ranged from 0 to 13. The serum P_4 level in pregnant and non pregnant does was not significantly different on days 0, 7 and 9 ($P>0.05$).

The oestrus response, oestrus onset interval, duration of oestrum and conception rate in Group IIB was 81.8 per cent, 54 ± 1.006 h, 39.77 ± 1.54 h and 66.66 per cent respectively. The oestrus intensity scores in induced oestrus ranged from 0 to 13. The serum progesterone level in does that became pregnant and those that were non pregnant were not significantly different on day 0, 11, and at 72 and 96 h. In Group II C the duration of oestrum and pregnancy rates was 40 ± 0.91 h and 33.33 per cent respectively.

Pregnancy diagnosis was done at three months of gestation by abdominal palpation and the accuracy of the method was 90.9 per cent. Mean gestation length was 146.03 ± 0.76 days. Litter size at birth in Group IA, IB, IIA, IIB and IIC was 2, 2, 2, 1.83 and 2 respectively. Average birth weight of kids was 2.35 ± 0.164 kg and the mean birthweight of male and female kid was 2.42 ± 0.98 kg and 2.28 ± 0.36 kg respectively.

Thus from the present study, it can be concluded that :-

1. Administration of GnRH on the day of oestrum in animals exhibiting pronounced oestrus signs failed to improve conception rate when compared to the control.

2. In animals exhibiting weak oestrus signs both CO-Synch and double prostaglandin protocols resulted in higher conception rate when compared to control group.

3. The double prostaglandin protocol was found to be more efficient in improving conception rate in animals exhibiting weak oestrus signs.