SYNCHRONISATION OF OESTRUS, SUPEROVULATION AND EMBRYO COLLECTION IN GOATS

By

BENJAMIN. E. D.

THESIS

Submitted in partial fulfilment of the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Reproduction
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy Thrissur

1994

DECLARATION

I hereby declare that the thesis entitled "Synchronisation of Oestrus Superovulation and Embryo Collection 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

Mannuthy
27 10 94

BENJAMIN E D

CERTIFICATE

Certified that the thesis entitled **Synchronisation of Oestrus Superovulation and Embryo Collection in Goats** is a record of research work done independently by Dr Benjamin E D under my guidance and supervision and that it has not previously formed the basis for the award of any degree fellowship or associateship to him

27 x 94

Dr M S NAIR

(Chairman Advisory Committee)

Associate Director of Research(V & AS)

Kerala Agricultural University

Vellanikkara

Mannuthy

27 10 94

CERTIFICATE

We the undersigned members of the Advisory Committee of Dr Benjamin E D a candidate for the degree of Master of Veterinary Science in Animal Reproduction agree that the thesis entitled **Synchronisation of Oestrus Superovulation and Embryo Collection in Goats"** may be submitted by Dr Benjamin E D in partial fulfilment of the requirement for the degree

Dr M S Nair
Associate Director of Research (V & AS)
Kerala Agricultural University
Chairman Advisory Committee

Dr C P Neelakanta Iyer
Professor and Head
Dept of Animal Reproduction
(Member)

Dr E Mathai
Professor
Dept of Animal Reproduction
(Member)

Dr B Nandakumar
Associate Professor
Centre of Advanced Studies in
Animal Breeding and Genetics
(Member)

External Examiner

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Dr M S Nair Associate Director of Research (V & AS) Kerala Agricultural University Vellanikara Chairman Advisory Committee for the keen interest in the study valuable guidance and untiring support rendered throughout the period of study

I am deeply indebted to Dr C P Neelakanta Iyer Professor and Head Department of Animal Reproduction and member of the advisory committee for his meticulous guidance constant encouragement and paternal affection shown to me during the course of my research

I express my profound gratitude to Dr E Mathai Professor Department of Animal Reproduction for his timely help and encouragement as a member of the advisory committee

I am very much grateful to Dr B Nandakumar Associate Professor Centre for Advanced Studies in Animal Breeding and Genetics for his advice and support as a member of the advisory committee

My thanks are due to Dr S Ravindran Nayar Professor Department of Surgery and other members of the staff of the Department of Surgery for the valuable guidance and assistance rendered during the surgical procedures

I owe my gratitude to Dr E Madhavan Professor Department of Animal Reproduction for the sincere and most commendable assistance rendered throughout the preparation of the thesis

I express my sincere gratitude to Dr K Prabhakaran Nair Professor Dr V Sudarsanan Professor Dr S P Suresan Nair Assistant Professor Dr K N Aravinda Ghosh Associate Professor and other members of the staff Department of Animal Reproduction for their constant help and valuable suggestions

I take this opportunity to pay homage to late Dr G Nirmalan Dean in charge College of Veterinary and Animal Sciences Mannuthy who personally inspired me throughout the period of my work

I appreciate the wholehearted co operation help and motivation offered to me by my colleagues Viju George A M Vahida Ani S Das John Martin K D Syam K Venugopal Raj Menon P R Pradeep Kumar Deepak S Tulpule Sivakumar

Jacob T C Bindu K A Sheela Yohannan Joseph Mathew Fabiana Lobo Joy George and many others

I express my deep felt gratitude to Dr A Rajan Dean College of Veterinary and Animal Sciences Mannuthy for providing the necessary facilities to carry out this work

I am thankful to the Kerala Agricultural University for awarding me the KAU fellowship for the period of study

I am short of words to express my gratitude to my parents and family members who had been the main support during my study

Benjamin E D

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

INTRODUCTION

Embryo transfer is a recent development in animal breeding Widespread application of artificial insemination had a great impact on livestock improvement The onset of embryo transfer has widened the scope in many ways The advantages of embryo transfer in animals range from genetic improvement of breed to preservation of endangered species Embryo transfer helps in rapid multiplication of breeds and increases the reproductive efficiency Specific improvement in the genetic character can be achieved by transfer of embryos from superior breeds to inferior ones

Although embryo transfer has become a common procedure in dairy cattle breeding it is yet to be practical in small domestic animals The necessity of surgical retrieval and transfer of embryos has restricted the exploitation of the advantages offered by embryo transfer in goat herd improvement A few studies are available on the caprine embryo transfer The contribution to meat and milk production from the goat population of the country does not commensurate with their large number Therefore there is tremendous scope for improvement in this area by employing multiple ovulation and embryo transfer techniques

The first successful embryo transfer in goats was reported by Warwick and Berry (1949) The commercial value of embryo production technology in the multiplication of exceptionally high yielding animals has been recognised in the developed countries The first successful embryo transfer in goats in India was reported by Agrawal *et al* (1982) Compared to other countries however the development in this field in our country is meagre There are several reasons for the lack of popularity of embryo transfer in India It is a complex and sophisticated method The hormones and other reagents are expensive Keen observation and timely detection are inevitable for a close synchronisation of oestrous cycles of donor and recipient animals Intensive research has been done to standardise suitable techniques for collection preservation and transplantation of embryos in sheep (Zanwar 1981) However such information is not readily available in goats

The present work attempts to standardise the technique for synchronisation of oestrus superovulation and embryo collection in goats The ultimate objective is to employ the embryo transfer technology as a tool for the genetic improvement of goats in Kerala

Review of Literature

REVIEW OF LITERATURE

2 1 SYNCHRONISATION OF OESTRUS

Oestrus or oestrous cycle profile is an important trait which affects the overall reproductive efficiency of an animal The different agro climatic factors managemental practices feeding pattern and photoperiodicity are some of the important factors which are known to influence the oestrus activity of goats Because of these oestrus detection is a laborious and time consuming process and manipulation of normal cyclical activity thus gains paramount importance There are many different methods available for synchronisation of oestrus one of which is by the use of exogenous hormones Prostaglandins and progesterones are most widely used

2 1 1 Synchronisation of Oestrus using Prostaglandin

The length of interoestrous interval in most domestic species is controlled by the duration of the life span of the corpus luteum Premature lysis of corpus luteum by administration of prostaglandin F2 alpha ($PGF_{2\alpha}$) or its analogues was used to manipulate the normal pattern of cyclic activity Bosu *et al* (1978) observed that $PGF_{2\alpha}$ is luteolytic when administered to does 4 days after the end of

oestrum Ott *et al* (1980) opined that $PGF_{2\alpha}$ is luteolytic as early as day 4 of the oestrous cycle Arthur *et al* (1989a) reported that in cow mare ewe and doe developing corpus luteum is refractory to the actions of $PGF_{2\alpha}$ Since $PGF_{2\alpha}$ is not capable of effecting luteolysis in the early part of the oestrous cycle in goats all animals in a group of randomly cycling animals need not come to synchronised oestrus with a single injection In order to overcome this problem two injection regime of prostaglandin at an interval of 10 to 12 days was recommended (Perera *et al* 1978 Ott *et al* 1979 Westhuysen 1979 D Urso and Dell Aquila 1981 Costa *et al* 1982 Kılıcoglu *et al* 1985 Pandey *et al* 1985 Mgongo 1987 Ozsar 1987 Ishwar and Pandey 1990)

2 1 1 1 Oestrus response after $PGF_{2\alpha}$ administration

Perera *et al* (1978) reported that after two injections of cloprostenol 10 days apart to goats at unknown stages of oestrus 83 3% of the animal came into oestrus between 18 and 23 h after the second injection In 20 female goats at different stages of the oestrous cycle when given two doses of 8 mg $PGF_{2\alpha}$ all came into oestrus within 50 ± 4 h after the second injection (Ott *et al* 1979) Westhuysen (1979) also observed a similar result after giving estrumate a prostaglandin analogue 125 µg 12 days apart to a group of female goats Ott *et al* (1980) in another

experiment using 20 cyclic does also reported similarly with two doses of 8 mg of $PGF_{2\alpha}$ given 11 days apart and oestrus was observed within 50 ± 1 h of the second injection

D Urso and Dell Aquilla (1981) reported that after the administration of $PGF_{2\alpha}$ at a dose rate of 5 mg and 10 mg each given 11 days apart 80 9% and 76 2% of the females came into oestrus with an average interval of 1 85 and 2 25 days respectively Bretzlaff *et al* (1983) with varying doses of $PGF_{2\alpha}$ observed 100% and 75% of female goats in oestrus using 0 385 mg and 0 275 mg/kg body weight of $PGF_{2\alpha}$ respectively Kilicoglu *et al* (1985) observed a synchronisation rate of 84 6% with double injection of prostaglandin 10 days apart in a group of Saanen goats Pandey *et al* (1985) observed that in Black Bengal goats with two $PGF_{2\alpha}$ injections 11 days apart 70% of the non cycling groups 86 % of the short cycling groups and 100% of the normal cycling groups came into oestrus at an average of 167 3 + 13 6 h 100 3 ± 8 7 h and 113 3 + 90 h after the second $PGF_{2\alpha}$ injection respectively

Greyling and Neikerk (1986) reported that in three groups of goats injected twice with 62 5 125 or 250 µg of cloprostenol at an interval of 14 days oestrus was induced in 93 8 87 5 and 100% of the animals respectively after the

second injection at an average interval of 55 3 h after the second injection Pandiya and Rathor (1986) by giving two injections of 5 mg $PGF_{2\alpha}$ 11 days apart found all in oestrus within 36 33 + 3 43 h of second prostaglandin injection Cox *et al* (1987) observed 95% of oestrus synchronisation after second injection of 0 12 mg of the prostaglandin $F_{2\alpha}$ analogue Tiaprost and reported an interval from $PGF_{2\alpha}$ injection to the onset of oestrus as 48 2 ± 15 7 h

Mgongo (1987) found that by giving two 125 µg cloprostenol injection 11 days apart all females came into oestrus within 68 h of second injection Na *et al* (1987) reported that by giving 5 mg $PGF_{2\alpha}$ injection to 59 female native Korean goats 45 came to oestrus at an average of 53 00 + 1 52 h after the treatment

Ozsar *et al* (1987) observed that when two injections of 5 mg $PGF_{2\alpha}$ were given 11 days apart 90% of the goats came into oestrus at an average of 50 0 ± 4 89 h after the treatment Ishwar and Pandey (1990) also recorded 100% oestrus response in goats following two doses of 10 mg $PGF_{2\alpha}$ given 11 days apart

2 1 1 2 Duration of oestrus in goats synchronised using $PGF_{2\alpha}$

Pandey *et al* (1985) reported that after two injections of $PGF_{2\alpha}$ in a group of Black Bengal goats the duration of oestrus averaged 20 0 ± 2 5 17 3 ± 1 8 16 0 ± 1 6 and 20 h respectively in non cycling short cycling normally cycling and nymphomaniac goats Wani *et al* (1985) by administering 250 µg $PGF_{2\alpha}$ on day 15 16 of the oestrous cycle to a group of miniature and crossbred German goats and Barbari goats in India found average duration of oestrus as 54 7 h and 34 9 h respectively The duration of oestrus was 41 9 h when two injections of estrumate was given 14 days apart (Greyling and Niekerk 1986) Pandiya and Rathor (1986) observed an average duration of oestrus as 44 00 ± 3 7 h (range 24 72 h) in a group of Amritsar goats synchronised with two prostaglandin injections of 5 mg each 11 days apart Ishwar and Pandey (1990) found an average duration of oestrus as 35 29 ± 3 09 in Black Bengal goats when two doses of $PGF_{2\alpha}$ was given 11 days apart

2 1 2 Synchronisation of Oestrus using Progesterone

Nishikawa *et al* (1963b) were the first to report results of synchronisation of oestrus in goats using progesterone The exogenous progestogens act in the same way

as a corpus luteum resulting in a negative feed back effect upon the anterior pituitary and a suppression of cyclic activity initiated by the release of gonadotrophins When the source of progestogen is withdrawn or its effect declines there was a return to cyclic activity Moore and Eppleston (1979b) in comparing the kidding percentage of embryo transfer recipient goats synchronised using progestogen impregnated intravaginal pessaries or prostaglandin injection reported no significant difference Westhuysen (1979) reported that by using intravaginal sponges with 60 mg medroxy progesterone acetate for synchronisation of oestrus 75% of the female goats came into oestrus after the treatment whereas Welch and Tervit (1984) reported that using silicone elastomer progesterone dispensers and sponges inserted for 18 days 82% of the treated female goats came to synchronised oestrus within an interval of 1 to 4 days after treatment Kilicoglu *et al* (1985) observed an oestrus synchronisation rate of 96% in Saanen goats Indramani and Vadnere (1989) also reported a synchronisation rate of 100% by using 12 mg progesterone for seven days while other workers obtained a lower rate using progestogen therapy (Agrawal 1987a Ishwar and Pandey 1990 Doijode *et al* 1991)

2 1 2 1 Oestrus response after progesterone treatment

Nishikawa *et al* (1963b) observed oestrus within 2 3 days after 10 mg progesterone injection given daily for 6 13 days Moore and Eppleston (1979a) observed that using intravaginal pessaries containing 20 mg cronolone placed insitu for 16 to 20 days oestrus occurred 36 48 h after withdrawal of pessaries and 72% of the animals were inseminated Westhuysen (1979) also found that using intravaginal sponges with 60 mg MAP for oestrus synchronisation 75% of the animals came to oestrus at an average of 57 0 h after the withdrawal of sponges Tervit (1981) found that in an embryo transfer programme using intravaginal sponges containing 60 mg MAP for 18 days oestrus occurred at an average of 2 4 days after the sponge withdrawal Goold and Tervit (1982) observed that when goats were treated with 60 mg MAP sponges for 17 5 days oestrus occurred within 3 0 days afte the sponge removal In another study Goold and Tervit (1984) reported that oestrus occurred 3 5 days after the removal of intravaginal sponge

Welch and Tervit (1984) observed that 82% of female goats came to synchronised oestrus 24 48 h after treatment with silicone elastomer progesterone dispensers for 18 days Kilicoglu *et al* (1985) obtained an oestrus synchronisation rate of 96% in Saanen goats treated with a medroxy

progesterone acetate (60mg) sponge Kıessling *et al* (1986) reported an oestrus synchronısatıon rate of 100% ın goats treated wıth vagınal progesterone pessarıes ın the form of fluorogeston- acetate or medroxy progesterone acetate ımpregnated sponges and the oestrus occurred wıthın 48 h of sponge removal Agrawal (1987b) observed a synchronısatıon rate of 96 12% by admınıstering melengestrol acetate @ 0 15 mg/anımal ın feed for 16 days In another study he reported an oestrus synchronısatıon rate of 82 14% wıthın 4 days after the last treatment wıth melengestrol acetate at the rate of 0 15 mg per anımal Agrawal (1987 a) ın an attempt to ınduce oestrus ın anoestrus goats usıng melengestrol acetate @ 0 15 mg/anımal for 16 days 86 6% showed oestrus wıthın 21 days of wıthdrawal of treatment Ozsar *et al* (1987) observed 80% oestrus synchronısatıon ın Angora goats usıng ıntravagınal sponge ımpregnated wıth 60 mg medroxy progesterone acetate for 14 days and the average ınterval between onset of oestrus and wıthdrawal of sponge was 64 5 ± 14 25 h

Indramanı and Vadnere (1989) reported 100% oestrus synchronısatıon rate usıng 12 mg progesterone ınjectıon for seven days Ishwar and Pandey (1990) obtaıned synchronısatıon rate of 90% usıng 12 5 mg progesterone ınjectıon of 16 days Sımılar result was also observed by gıvıng 12 5 mg progesterone ınjectıon daıly for 14 to 17

days with oestrus occurring 80 52 + 3 04 h after the treatment (Doijode *et al* 1991)

2 1 2 2 Duration of oestrus in progesterone synchronised goats

Nishikawa *et al* (1963b) reported the duration of oestrus as 1 5 to 3 days following injection of 10 mg of progesterone daily for 6 13 days Agrawal (1987 b) reported the duration of oestrus as 33 12 ± 2 79 h in a group of female goats synchronised using melengestrol acetate @ 0 15 mg /animal for 16 days Ishwar and Pandey (1990) observed 36 55 ± 2 86 h as duration of oestrus in goats injected with 12 5 mg progesterone daily for 16 days whereas Doijode *et al* (1991) reported an average duration of 24 94 + 0 78 h in goats injected with 12 5 mg progesterone for 14 to 17 days

2 2 Superovulation

The two important gonadotrophins used for superovulation in goats are pregnant mare serum gonadatrophin (PMSG) or equine chorionic gonadotrophin (eCG) and follicle stimulating hormore (FSH) Nishikawa *et al* (1963b) induced superovulation by giving PMS + hCG in a group of female goats with an average recovery of 106 ova

from 11 goats In another study Nishikawa *et al* (1963b) reported that using PMS oestru commenced 2 5 days after the last PMS injection eCG ha a longer biological half life than FSH consequently a single injection of eCG will induce superovulation FSH require a multiple injection treatment regime for optimum effect However Arthur *et al* (1989b) reported that the long half life of eCG can be sometimes a disadvantage as its effect persists even after induced oestrus thereby affecting the recovery rate of embryos

2 2 1 Superovulation in goats synchronised using prostaglandin

Ott *et al* (1979) successfully synchronised oestrus in all goats by giving 250 or 750 IU of PMSG followed by 4 mg PG $F_{2\alpha}$ 48 h later The average number of ovulations per female was 1 6 and 6 8 for 2 0 IU and 750 IU of PMSG respectively

By using PMSG 750 1000 IU for superovulation and a prostaglandin analogue two days later all the goats came to oestrus 30 48 h after the prostaglandin injection (Armstrong and Evans 1983) The average ovulation rate was 10 8 ± 1 2

2 2 1 1 Oestrus response in superovulated animals

Ott *et al* (1979) observed that by giving 250 or 750 IU PMSG followed 48 h later by 4 mg $PGF_{2\alpha}$ 100% of the animals evinced oestrus within 3 h after the prostaglandin injection Pandiya and Rathor (1986) reported that by using 1500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ 100% of the animals showed oestrus and the average ovulation was 8 Elamvitayakorn *et al* (1988) found that 1000 IU PMSG followed by 10 mg $PGF_{2\alpha}$ 48 to 72 h later oestrus occurred 1 2 + 0 03 days after the second injection with an average duration of oestrus 1 3 ± 0 4 days Mahmood *et al* (1991) reported that by using 500 to 750 IU PMSG for superovulation followed 60 h later by a prostaglandin analogue all the females came to oestrus and the average number of ovulation was 11 7 ± 8 07 According to Pandey *et al* (1991) the average duration of oestrus was 18 66 ± 2 6 h in cyclic goats receiving PMSG and $PGF_{2\alpha}$ injection Ryot and Vadnere (1991) observed all animals in oestrus by injecting 1000 IU PMSG followed 24 h later by 600 IU PMSG and 7 5 mg $PGF_{2\alpha}$ 24 h after the prostaglandin injection

Pandey *et al* (1992) reported that by the use of 750 IU PMSG followed by 5 mg $PGF_{2\alpha}$ 24 h later all the goats came to synchronised oestrus Thilagar *et al* (1992) recorded an oestrus synchronisation rate of 83 3% in female

goats injected with 7 5 mg $PGF_{2\alpha}$ 11 days apart and 1000 IU PMSG given 24 h before the second dose of $PGF_{2\alpha}$ Oestrus occurred 32 0 ± 1 22 h after the second prostaglandin injection

2 2 1 2 Superovulatory response after injection of eCG and $PGF_{2\alpha}$

Ott *et al* (1979) by using 250 or 750 IU PMSG followed by 48 h later with 4 mg $PGF_{2\alpha}$ the number of ovulations per female was 1 6 and 6 8 respectively Armstrong and Evans (1983) by using 750 1000 IU PMSG for superovulation and a prostaglandin $F_{2\alpha}$ analogue injection two days later found an average ovulation rate of 10 8 ± 1 2 Inderjeet and Gupta (1985) observed an average ovulation rate of 12 0 ± 2 49 in goats treated with 1000 IU PMSG followed 48 h later with 100µg of a $PGF_{2\alpha}$ analogue Pandiya and Rathor (1986) reported an average ovulation rate of 8 0 and an average unruptured follicle of 4 25 when treated with 1500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ Elamvitayakorn *et al* (1988) obtained an average ovulation rate of 5 7 ± 2 5 by injecting 1000 IU PMSG on day 15 17 of the oestrus cycle followed 48 72 h later by 10 mg $PGF_{2\alpha}$ Mahmood *et al* (1991) recorded an average ovulation rate of 11 70 ± 8 07 and an average unruptured follicle of 3 60 ± 2 67 by using 500 to 750 IU PMSG followed 60 h later by an injection of prostaglandin

analogue An average ovulation rate of 11 33 and percentage of ovulation of 77 27 were reported by Ryot and Vadnere (1991) after giving 1000 IU PMSG followed 24 h later by 600 IU PMSG and 7 5 mg $PGF_{2\alpha}$ and 1500 IU of hCG on the day of oestrus Pandey *et al* (1992) reported an average ovulation rate of 9 8 by using 750 IU PMSG followed by 5 mg $PGF_{2\alpha}$ 24 h later and 500 IU of hCG on the day of oestrus Thilagar *et al* (1992) found an average ovulation rate of 2 67 in indigenous goats treated with two injections of 7 5 mg $PGF_{2\alpha}$ given 11 days apart and 500 IU PMSG given 24 h before the second $PGF_{2\alpha}$ injection

2 2 2 Superovulation in progesterone synchronised goats

Van rensburg (1964) reported that when 20 mg progesterone injection daily for five days and 750 IU PMS or 500 IU PMS + 250 IU LH or 6 injections of horse anterior pituitary extract totalling 90 mg and 10 mg progesterone 24 h after the last progesterone injection of 20 mg were given an overall ovulation rate of 4 8 and 3 0 was observed for the Boer and Angora breeds of goats Suh *et al* (1975) could obtain an ovulation rate of 4 0 and 6 6 per animal by superovulation in 40 goats with progesterone followed by 750 and 1000 IU PMS and 100 IU hCG given on the day of mating Moore and Eppleston (1979b) observed an average ovulation rate of 13 7 ± 2 2 in goats treated with 1500 IU PMSG at the

end of a progesterone treatment with 12 mg/day Ahmed and Maurya (1981) also observed similar results in animals treated with daily injections of 10 mg hydroxy progesterone caproate for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating

2 2 2 1 Oestrus response in superovulated animals

Aurstad and Gysler (1979) noticed that when 30 goats were fed 50 mg MAP daily for 10 days with 500 IU PMSG on day 10 all goats exhibited oestrus within two days of end of treatment Moore and Eppleston (1979b) administered 1500 IU PMSG in a group of goats treated with 12 mg progesterone per day Oestrus in all the females occurred within 48 60 h after the end of treatment Ahmed and Maurya (1981) also found that by giving 10 mg progesterone daily for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later all female goats exhibited oestrus within 1 2 days of final PMSG injection

Tervit (1981) treated Angora female goats with 12 mg progesterone daily for 17 days and PMSG on day 16 to induce superovulation and found that oestrus occurred in an average of 3 6 days after the last injection with an average ovulation rate of 8 0 Bongso *et al* (1982) also reported

that progestogen impregnated intravaginal sponges left in place for 17 days followed by an injection of PMSG (300 IU) at sponge withdrawal resulted in 89 5% of the goats exhibiting oestrus within 96 h of the sponge withdrawal

Debenedetti and Lucaroni (1982) noted that injecting 250 750 IU PMSG on the day of removal of a subcutaneous implant containing 375 mg progesterone all female goats in treatment evinced oestrus within a 4 day period after the implant removal Goold and Tervit (1982) noticed 100% response by giving 12 mg progesterone daily for 17 days and by giving PMSG on the 16th day The same authors in another expeiment with 12 mg progesterone for 17 days and PMSG on the 16th day found that 100% of the animals were in oestrus 2 9 days after the last progesterone injection (Goold and Tervit 1984)

Agrawal (1986) observed that by administering melengestrol acetate @ 0 15 mg/animals/day for 16 days and PMSG 400 to 1000 IU on the last day of MGA feeding 77 22% of the goats came to oestrus within 4 day of the treatment Kiessling *et al* (1986) reported that by using PMSG (20 IU/Kg body wt) administered on day 17th of the 18 20 day vaginal progesterone pessary treatment regime 100% of goats came to oestrus within 48 h of sponge removal Goswami *et al* (1987) in an attempt for inducing oestrus in anoestrus

goats by feeding 5 mg MAP daily for 14 days and injecting 500 IU of PMSG after the last day of feeding reported that 60% of the anestrous goats came to oestrus 54 60 h after the injection of PMSG East and Rowe (1989) reported that by using a vaginal sponge containing 30 mg FGA for 16 days and an injection of 250 IU PMSG 2 days before sponge removal 95 1% of the female goats showed oestrus within 72 h of sponge removal

Indramani and Vadnere (1989) reported that 1000 IU PMSG given 24 h after withdrawal of a progesterone therapy of 12 mg for seven days and 400 IU PMSG given on the following day and 1000 IU chorionic gonadotrophin given 12 h after the onset of oestrus 100% of the goats came to oestrus within one to two days of the final PMSG injection Selgrath *et al* (1990) while comparing the superouvulatory response of PMSG and FSH reported that by giving 1000 IU PMSG 24 h prior to the removal of a norgestomet ear implant maintained for 14 21 days all females were in oestrus at an average of 32 9 h after the implant removal Ryot and Vadnere (1991) also observed that 12 5 mg progesterone injection given daily for 14 days with 1000 IU PMSG given 24 h after withdrawal of progesterone therapy and 600 IU PMSG 24 h later all female goats exhibited oestrus 1 day after second injection of PMSG

Doijode *et al* (1992a) found that after injecting progesterone @ 12 5 mg/animal daily for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG 66 6% of the treated animals exhibited oestrus within 76 62 + 20 98 h after the treatment Doijode *et al* (1992b) reported that administration of progesterone @ 12 5 mg/animal/day for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG 66 66% of the treated animals came to oestrus within 59 87 ± 2 33 h after the PMSG treatment with duration of oestrus as 22 5 + 0 23 h Pargaonkar *et al* (199?) reported that after administering progesterone @ 12 › mg/animal/ day for 14 and 16 days and 1000 IU PMSG on 13th and 15th day and 1500 IU hCG on the day of oestrus 87 ›% of the animals came to oestrus within 96 h after the PMSG injecti›n with an average duration of oestrus as 24 to 36 hours Thilagar *et al* (1992) reported that after using ear implants containing 3 mg norgestomet for 11 days and 500 IU PMSG 24 h before removal of ear implant 100% of the animals evinced oestrus within 24 67 + 1 12 h after removal of implant

2 2 2 2 Superovulatory response after treatment with eCG and progesterone

Nishikawa *et al* (1963a) published reports on superovulation in goats using a total do e of 1500 IU PMS and 500 or 1000 IU hCC An average of 25 5 follicles were

developed in both ovaries with an ovulation percentage varying from 27 2 to 80 between females Van rensburg (1964) reported an average ovulation rate of 4 8 and 3 0 in Boer and Angora female goats treated with 20 mg progesterone for five days followed by 750 IU PMS 500 IU PMS + 250 IU LH Suh *et al* (1975) reported an average ovulation rate of 4 0 and 6 6 per female when superovulation was induced in 40 goats with progesterone followed by 750 and 1000 IU PMS and 1000 IU hCG given on the day of mating Moore and Eppleston (1979b) observed an average ovulation rate of 13 7 + 2 2 in goats treated with 1500 IU PMSG given at the end of a progesterone treatment of 12 mg/day An ovulation rate of 12 54 in goats treated with daily injections of 10 mg hydroxy progesterone caproate for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating was observed by Ahmed and Maurya (1981)

Tervit (1981) obtained an average ovulation rate of 8 0 in Angora female goats treated with 12 mg progesterone daily for 17 days and PMSG on day 16 to induce superovulation Agrawal *et al* (1982) observed in ovulation rate of 3 2 in female goats synchronised by feeding melengestrol acetate @ 0 15 mg/animal for 16 days and superovulated with injection of PMSG on the last day of melengestrol acetate feeding According to Goold and Tervit (1982) 12 mg

progesterone daily for 17 days and PMSG on the 16th day resulted in an average ovulation rate of 9 9 The same authors in another experiment with 12 mg progesterone for 17 days and PMSG on the 16th day obtained an average ovulation rate of 9 1 (Goold and Tervit 1984) Agrawal (1986) noticed an ovulation rate of 7 83 + 1 01 in Barbari goats by administering melengestrol acetate @ 0 15 mg/animal/day for 16 days and by injecting 1000 IU PMSG on the last day of MGA feeding Kiessling *et al* (1986) administered PMSG (20 IU/Kg body wt) on day 17 of the 18 20 day vaginal progesterone pessary treatment regime and obtained an ovulation rate of 6 ± 2

Indramani and Vadnere (1989) reported an average ovulation rate of 10 62 and average unruptured follicle rate of 3 25 by using 1000 IU PMSG given 24 h after withdrawal of a progesterone therapy of 12 mg for seven days and 400 IU PMSG given on the following day and 1000 IU chorionic gonadotrophin given 12 h after the onset of oestrum Selgrath *et al* (1990) obtained an average ovulation rate of 7 7 ± 5 0 in female goats injected with 1000 IU PMSG 24 h prior to the removal of a norgestomet ear implant maintained for 14 to 21 days Ryot and Vadnere (1991) observed that 12 5 mg progesterone injection given daily for 14 days with 1000 IU PMSG given 24 h after withdrawal of progesterone therapy and 600 IU PMSG 24 h later and 1500 IU of hCG given

the next day on appearance of oestrus resulted in an ovulation rate of 16 33 Doijode *et al* (1992a) reported that administration of progesterone @ 12 5 mg/animal/day for 14 to 17 days and 1000 IU PMSG and 1500 hCG resulted in an average ovulation rate of 3 12 ± 0 75 and average unruptured follicles of 6 62 ± 1 34

Pargaonkar *et al* (1992) reported that after administering progesterone @ 12 5 mg/ animal/day for 14 and 16 days and 1000 IU PMSG given on 13th and 15th day of progesterone treatment and 1500 IU hCG given on the day of oestrus an average ovulation rate of 9 42 + 1 48 and average unruptured follicles of 1 85 ± 0 06 were obtained Thilagar *et al* (1992) reported that after using ear implants containing 3 mg norgestomet for 11 days and 500 IU PMSG 24 h before removal of ear implant an average ovulation rate of 4 0 could be obtained

2 3 EMBRYO COLLECTION

The first successful embryo collection and transfer in goat was reported by Warwick and Berry (1949) Nishikawa *et al* (1963b) published reports of collection of embryos from female goats superovulated with PMSG and hCG and collected two to three days after oestrus Suh *et al* (1975) reported that inducing superovulation in progesterone treated females

and by giving 1000 IU hCG at the time of mating 79 % of embryos could be collected by conducting laparatomy 72 h after the onset of oestrus

2 3 1 Embryo collection in goats synchronised using prostaglandin

Armstrong and Evans (1983) reported use of 750 1000 IU PMSG for superovulation and a prostaglandin analogue two days later with an average ovulation rate of 10 8 ± 1 2 and embryo recovery rate of 7 9 + 1 2 Inderjeet and Gupta (1985) observed an average ovulation rate of 12 0 ± 2 49 and a mean embryo recovery rate of 75 to 80% for embryo collection attempted on days 3 and 4 after onset of oestrus in goats superovulated with 1000 IU PMSG followed by 100 µg of a $PGF_{2\alpha}$ analogue Pandiya and Rathor (1986) reported that using 1500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ the mean number of embryos recovered was 4 75 with an embryo recovery percentage of 59 37

Na *et al* (1987) observed that in native Korean goats synchronised with $PGF_{2\alpha}$ an injection of 1000 IU PMSG produced an average ovulation rate of 3 22 + 1 47 and an embryo recovery of 76 67 percent Tsunoda and Sugie (1989) obtained an average of 5 7 ± 4 4 embryos per female using PMSG for superovulation and $PGF_{2\alpha}$ for synchronisation

Mahmood *et al* (1991) used PMSG and FSH P for superovulation in Pashmina goats and reported that using 500 IU to 750 IU PMSG for superovulation followed 60 h later injection of prostaglandin analogue resulted in an average embryo recovery rate of 2 50 ± 5 02 Ryot and Vadnere (1991) administered 1000 IU PMSG followed 24 h later by 600 IU PMSG and 7 5 mg $PGF_{2\alpha}$ and 1500 IU of hCG on the day of oestrus An average embryo recovery rate of 8 0 and percentage of embryo recovery rate of 70 59 was reported

By using 750 IU PMSG followed by 3 mg $PGF_{2\alpha}$ 24 h later and 500 IU of hCG on the day of oestrus Pandey *et al* (1992) reported an average ovulation rate of 8 6 and average embryo recovery rate of 5 3 Embryo collection attempted on 3^{rd} and 4^{th} day of oestrus resulted in an embryo recovery of 61 53 per cent Thilagar *et al* (1992) found an average embryo recovery rate of 1 67 in indigenous goats treated with two injections of 7 5 mg $PGF_{2\alpha}$ given 11 days apart and 500 IU PMSG given 24 h prior to the second $PGF_{2\alpha}$ injection

2 3 2 Embryo collection in goats synchronised using progesterone

Ahmed and Maurya (1981) reported an embryo recovery rate of 77 41% and ovulation rate of 12 54 in animals treated with daily injections of 10 mg hydroxy progesterone

caproate for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating Tervit (1981) observed an average ovulation rate of 8 0 and average fertilised egg recovery of 5 8 in Angora female goats treated with 12 mg progesterone daily for 17 days and PMSG on day 16 to induce superovulation Agrawal *et al* (1982) observed 52 7% of embryo recovery in female goats synchronised by feeding melengestrol acetate @ 0 15 mg/animal for 16 days and superovulated with an injection of PMSG on the last day of melengestrol acetate feeding Goold and Tervit (1982) reported that by giving 12 mg progesterone daily for 17 days and PMSG on the 16th day an average number of fertilised ova obtained was 6 7

Agrawal *et al* (1983) obtained a fertilised ova recovery rate of 4 25 in Barbari female goats treated with an injection of 400 1000 IU PMSG on the last day of feeding melengestrol acetate @ 0 15 mg/day for 16 days Goold and Tervit (1984) using PMSG on the 16th day of a 17 day treatment regime with progesterone 12 mg per day an average number of fertilised ova obtained was 6 0 Kiessling *et al* (1986) found that by using PMSG (20 IU/kg body wt) administered on day 17 of the 18 20 day vaginal progesterone pessary treatment regimen an average 4 to 12 cell embryo recovery rate of 2 + 2 was obtained Selgrath *et al* (1990)

found a total ova recovery rate of 3 6 + 3 4 in female goats injected with 1000 IU PMSG 24 h prior to the removal of a norgestomet ear implant maintained for 14 to 21 days Ryot and Vadnere (1991) observed that with 12 5 mg progesterone injection given daily for 14 days with 1000 IU PMSG given 24 h after withdrawal of progesterone therapy and 600 IU PMSG 24 h later and 1500 IU of hCG given the next day on appearance of oestrus a total ova recovery rate of 9 67 and percentage ova recovery of 59 18 and an embryo recovery rate of 7 0 was obtained

Doijode *et al* (1992a) reported that after administering progesterone @ 12 5 mg/animal/day for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG an average egg recovery rate of 0 875 and fertilised egg recovery rate of 0 428 was obtained Pargaonkar *et al* (1992) reported that after administering progesterone @ 12 5 mg/animal/day for 14 and 16 days and 1000 IU PMSG given on 13th and 15th day of progesterone treatment and 1500 IU hCG given on the day of oestrus mean ova recovery rate of 7 42 + 1 73 and overall mean percentage of fertilised ova was 86 5 + 5 0 Thilagar *et al* (1992) reported that after using ear implants containing 3 mg norgestomet for 11 days and 500 IU PMSG given 24 h before removal of ear implant an average ova recovery rate of 2 67 was obtained

2 3 3 Embryo collection in control animals

Westhuysen (1979) observed an average ovulation rate of 2 25 and 1 5 in females treated with 500 IU PMS and 5 mg stillboestrol during the breeding season and in the controls respectively Ott *et al* (1980) published that in 20 females injected with 8 mg $PGF_{2\alpha}$ 11 days apart the mean number of ovulations observed was 2 0 + 1 0 Agrawal (1986) reported an average ovulation rate of 1 41 ± 0 10 in female goats synchronised by feeding melengestrol acetate @ 0 15 mg/animal/day for 16 days Kiessling *et al* (1986) observed a mean ovulation rate of 1 5 in recipient goats synchronised with vaginal progesterone pessaries for 18 to 20 days

2 3 4 Quality of embryos collected

Suh *et al* (1975) found that by superovulation induced in 40 goats with progesterone followed by 750 and 1000 IU PMS and 1000 IU hCG given on the day of mating 79% of the ova recovered were fertilised Moore and Eppleston (1979b) reported that by giving 1500 IU PMSG to a group of progesterone synchronised goats the percentage of fertilised ova recovered was 46 with an average ovulation rate of 13 7 ± 2 2 Ahmed and Maurya (1981) reported an ovum fertilisation rate of 81 97% in goats treated with daily injections of 10 mg hydroxy progesterone caproate for 6 14

days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating

Tervit (1981) observed an average fertilised egg recovery of 5 8 in Angora goats treated with 12 mg progesterone daily for 17 days and PMSG on day 16 Agrawal *et al* (1982) observed 85 percentage of embryo with normal cleavage in female goats synchronised by feeding melengestrol acetate @ 0 15 mg/day for 16 days followed by superovulation with an injection of PMSG on the last day of melengestrol acetate feeding Inderjeet and Gupta (1985) found that 76 25% of the recovered ova were fertilised in goats superovulated with 1000 IU PMSG followed by 100 µg of a $PGF_{2\alpha}$ analogue Selgrath *et al* (1990) obtained an embryo recovery rate of 2 7 + 3 9 in female goats injected with 1000 IU PMSG 24 h prior to the removal of a norgestomet ear implant maintained for 14 to 21 days

Ryot and Vadnere (1991) noticed that after giving 1000 IU PMSG followed by 600 IU the following day in progesterone primed goats and those injected with 7 5 mg $PGF_{2\alpha}$ and after giving 1500 IU hCG on the day of oestrus the percentage of fertilisation of recovered ova were 72 14 in those primed with progesterone and 75 47 in those injected with $PGF_{2\alpha}$ Diojode *et al* (1992a) reported that

after administering progesterone @ 12 5 mg/animal/day for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG the overall percentage of eggs recovered and eggs fertilised was 24 17 and 45 83 respectively

Materials and Methods

MATERIALS AND METHODS

Eighteen healthy crossbred goats in the age group of one to five years maintained under the same agroclimatic and feeding conditions stationed in the University goat farm attached to the college of Veterinary and Animal Sciences Mannuthy formed the material for the study These animals were randomly allotted to three different groups with six animals in each group

3 1 Synchronisation of oestrus

In group I all the six animals were synchronised for oestrus with 10 mg of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$)* on day 1 irrespective of the stage of the oestrous cycle and second dose of 10 mg $PGF_{2\alpha}$ on day 12 as intramuscular injection

In group II synchronisation of oestrus was done by 12 5 mg each of progesterone** as intramuscular injection for 16 days starting on the same day in all animals irrespective of the oestrous cycle

The six animals in the third group were maintained as controls for the synchronisation study All the animals were

---

* Dinofertm Marketed by Alved Pharmaceuticals Madras 5 ml vial each ml containing 5 mg prostaglandin $F_{2\alpha}$

** Uniprogestin 25 Marketed by Unichem Laboratories Ltd Bombay 1 ml ampoule each containing 25 mg progesterone

observed for the onset intensity and duration of oestrus by using a teaser buck

All the animals were maintained separately and the respective treatments were repeated in group I and II after a period of 60 days

3 2 Superovulation

In group I superovulation was carried out with equine chorionic gonadotrophin (eCG) injection*** 1000 IU given as intramuscular injection on the day previous to second dose of $PGF_{2\alpha}$ in the second treatment after 60 days

In group II superovulation was done with eCG injection 1000 IU given as intramuscular injection on the 15th day of second treatment after 60 days

All the animals in the above two groups and the controls were inseminated with good quality buck semen four to six hours after the onset of oestrus and thereafter at 12 hour intervals till the end of oestrus

*** Foll gon 1000 IU 10 ml Marketed by Intervet Internat onal Holland

Laparotomy of the inseminated goats was performed three days after the onset of oestrus for counting the ovulation points on both the ovaries and for collecting the embryos

3 3 Embryo collection

Embryos were collected surgically in all the 18 goats three days after the onset of oestrus by flushing the fallopian tubes with the flushing media

3 3 1 Preparation of flushing medium

About 500 ml of sterile double distilled water was taken in a 1000 ml volumetric flask One vial of Dulbeccos Modified Eagle Medium was added into the flask The vial was rinsed several times with sterile double distilled water to deliver all the reagents in it The flask was then shaken vigorously till all the contents were dissolved 100000 IU of penicillin G sodium and 50 mg of streptomycin sulphate were added and mixed The solution was made upto 1000 ml by adding double distilled water The media was then collected in 100 ml sterile conical flasks The mouth and neck region of the flasks were covered with aluminium foil and they were kept in the refrigerator until use They were used within ten days of preparation

3 3 2 Preparation of the animal

Animals were kept off feed for 24 hours prior to surgery Hair at the site was shaved scrubbed with 2% Savlon solution mopped dry and painted with Tr Iodine An area about four cm ventral to the lateral edge of the transverse process of the third lumbar vertebra on the left flank just anterior to the thigh muscles was chosen as the site (Fig 1)

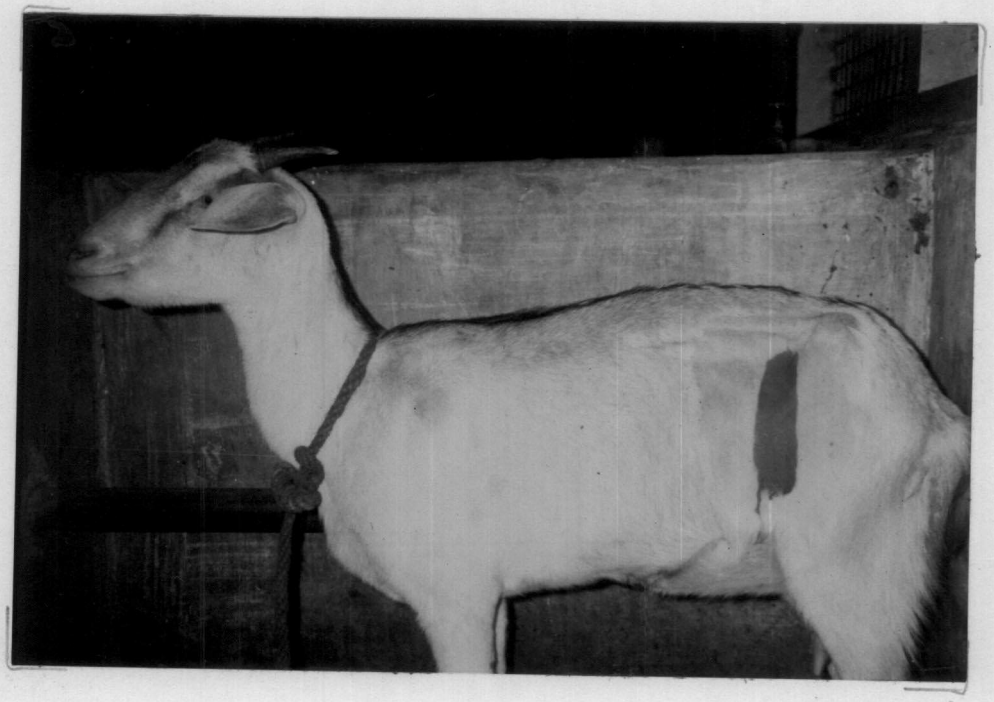
Xylazine* was injected at the rate of 0 2 mg/kg body weight intramuscularly for anaesthesia The site was infiltrated with 2% Lignocaine solution The animal was controlled and laid on right lateral recumbancy

3 3 3 Surgical Procedure

A vertical skin incision of about six cm was made at the site The muscles and connective tissue were incised and the peritoneum was opened by a nick incision and later extended exposing the visceral organs The ovaries were exteriorised and observations were made regarding the number of ovulation points on both the ovaries

*Xylaxin Marketed by Ind an Immunologicals Hyderabad 10 ml vial each ml containing 23 2 mg of xylazine hydrochloride

Fig 1 Site for laparotomy for collection of embryos



3 3 4 Collection Procedure

For embryo collection a smooth edged 22 gauge hypodermic needle attached to a syringe was inserted through the uterotubal junction into the lumen of the fallopian tube on one side The needle and the fallopian tube were held together by the pressure of the thumb and forefinger in such a way that the flow of the medium into the horn was prevented The media used was Dulbeccos Modified Eagle** to which 100 000 IU of penicillin G sodium and 50 mg of streptomycin sulphate per litre were added

A polythene tubing of about two mm diameter was inserted through the ostium of fimbria of the same side to a depth of two cm for collecting the tubal flushing in a petridish About 10 ml of the media was gently injected through the fallopian tube via the needle and collected in a sterile petridish using the inserted polythene tubing The process of collection was repeated for the fallopian tube on the other side The number of embryos collected from each side was recorded separately

The incision was sutured using silk in separate layers for peritoneum and muscles The skin was sutured using monofilament nylon The animals after surgery were treated

** Marketed by Himed a

with antibiotic injections for five days and the wounds were dressed until healing

The petridish containing the embryos were maintained in an incubator until it was examined A stereoscopic binocular microscope was used for identification and isolation of the embryos in the flushing medium As the embryos were located they were drawn into pasteur pipettes and transferred into fresh media in depression slides for further morphological studies These embryos were kept in BOD incubator at 37 C in fresh media until further use

3 4 Embryo transfer

For surgical transfer of embryos the recipient after synchronisation was prepared for surgery as in the case of the experimental animals and laparatomy was conducted at the same site used for embryo collection The ovaries were exposed for observing ovulation points The embryos for transfer were collected in a pasteur pipette The anterior part of the uterine horn was punctured with a hypodermic needle and through that puncture the tip of the pasteur pipette was introduced into the lumen and the fluid containing the embryos was gently evacuated The procedure was repeated on the other side The surgical incision was sutured in similar manner as for donor animals

The data were analysed as per the methods prescribed by Snedecor and Cochran (1967)

Results

RESULTS

With the aim of evolving effective methods for standardising techniques for synchronisation of oestrus superovulation and collection of embryos eighteen healthy goats were selected from the goat farm attached to the College of Veterinary and Animal Sciences Mannuthy and randomly divided into three different groups with six animals in each

For studies on synchronisation of oestrus six animals in the first group were given two doses of 10 mg $PGF_{2\alpha}$ 11 days apart and the six animals in the second group were given 12 5 mg progesterone injection daily for 16 days Six animals in the third group were not given any treatment and kept as control

For studies on superovulation and embryo collection the respective treatments were repeated in group I and II after a period of sixty days and superovulation in group I was carried out with equine chorionic gonadotrophin (eCG) injection 1000 IU given on the day previous to second dose of $PGF_{2\alpha}$ Superovulation in group II was done with 1000 IU eCG injection given on the 15^{th} day of progesterone treatment All the animals in the above two groups and the animals in the control group were inseminated with good

quality buck semen four to six hours after the onset of oestrus and thereafter at 12 hour intervals till the end of oestrus Embryos were collected surgically in all the 18 goats three days after the onset of oestrus by flushing the fallopian tube after conducting laparotomy of the inseminated goats on the left flank The results of the study on synchronisation of oestrus in the two groups superovulatory response in the two groups and the number of transferable and non transferable embryos collected from all the animals in the three groups are presented in Tables 1 to 8 and Fig 2 to 7

Influence of parity and age on superovulation observation on onset intensity and duration of oestrum in superovulated goats and subsequent reproductive status of experimental and control animals are presented in Tables 9 to 15

4 1 Synchronisation of Oestrus

4 1 1 Oestrus response after $PGF_{2\alpha}$ treatment

The results of oestrus response in goats using two dose regimen of $PGF_{2\alpha}$ given 11 days apart is shown in Table 1 It could be seen that all the treated animals were in oestrus after the second $PGF_{2\alpha}$ injection The interval between the

second injection of $PGF_{2\alpha}$ and the onset of oestrus varied from 42 h to 74 h with a mean of 57 8 ± 5 65 h

4 1 2 Duration of Oestrus

The duration of oestrus after the second prostaglandin injection ranged from 24 h to 72 h with a mean of 48 ± 8 76 h (Table 1)

4 1 3 Oestrus response after progesterone treatment

The results of synchronisation of oestrus using 12 5 mg progesterone injection daily for 16 days is furnished in Table 2 It could be seen that five out of six animals were in oestrus after the last progesterone injection The interval between the last progesterone injection and the onset of oestrus in animals evinced oestrus varied from 90 h to 120 h with a mean of 101 6 ± 6 11 h

4 1 4 Duration of Oestrus

The duration of oestrus after progesterone treatment varied from 24 h to 32 h with a mean of 28 + 1 41 h (Tab 2)

Statistical analysis of the data revealed no significant difference in the interval between treatment and

onset of oestrus percentage of animals responded to treatment and duration of oestrus between the two groups

4 2 Superovulation

4 2 1 Oestrus response after treatment with eCG and $PGF_{2\alpha}$

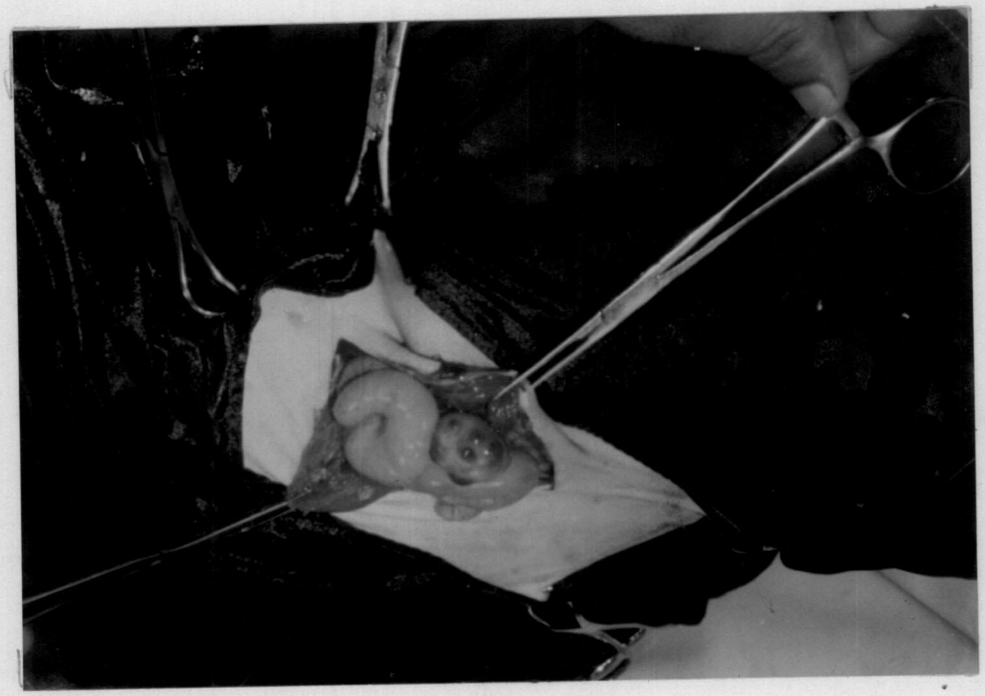
The results of administration of eCG in the second treatment regime are shown in Table 3

All the animals in this group evinced oestrus at an interval of 28 to 96 h (mean 50 3 + 10 86) after the second injection of $PGF_{2\alpha}$ The duration of oestrus after the second $PGF_{2\alpha}$ injection ranged from 24 h to 48 h with a mean of 44 ± 4 h

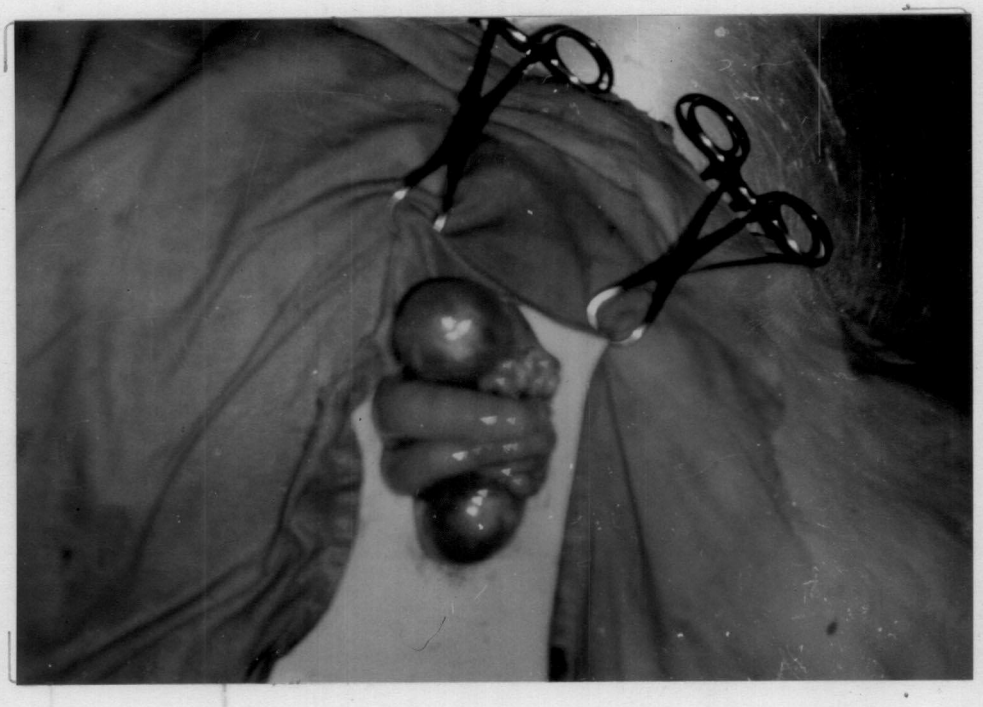
4 2 2 Superovulatory response after treatment with eCG and $PGF_{2\alpha}$

Data on the effect of superovulation is presented in Table 3 and Fig 2 The data revealed that the number of ovulation points in the right ovary ranged from 3 to 8 with a mean of 4 ± 1 30 In the left ovary the values were 3 to 7 with an average of 4 4 + 0 748 It could also be seen that the total number of ovulation points on both the ovaries averaged 8 4 + 1 94 with a range of 3 to 15

Fig 2 Group I Superovulation with eCG and $PGF_{2\alpha}$
Note the corpora lutea



ıc ɔ Group I Anımal No II failure ɔf ɔvu ɜ ıor
Note the cystıc enlarger



c ^ Animal No III fa1iu e r ›/u on

e e ged view

It could further be noted that the number of unruptured follicles on the right ovary varied from 1 to 6 with a mean of 2 3 ± 0 843 where as in the left ovary it ranged from 1 to 7 with a mean of 3 0 ± 0 987 The total number of unruptured follicles on both the ovaries was 5 3 ± 1 64 and it ranged from 2 to 13

One animal (No III) showed massive ovarian hyperstimulation with multiple cystic follicles (Fig 3 and 4) This goat conceived after two months of the experiment without any specific treatment and kidded

The right ovary of one animal in this group showed ovarobursal adhesion and hence no ovulation points coulc be detected on the ovary

4 2 3 Oestrus response after treatment with eCG and progesterone

The results of administration of eCG revealed that all the animals were in oestrus after the last progesterone injection (Tab 4) The interval between the last progesterone injection and onset of oestrus varied between 44 h to 96 h with a mean of 72 ± 9 06 h

The duration oestrus in this group ranged from 24 h to 48 h with a mean of 38 3 ± 4 46 h

4 2 4 Superovulatory response after treatment with eCG and progesterone

Data presented in Table 4 and Fig 5 to 6 showed the effect of superovulation using 1000 IU eCG on day 15 of second treatment regime of 12 5 mg progesterone injection daily for 16 days While the number of ovulation points on the right ovary ranged from 2 to 17 with a mean of 7 5 ± 2 31 the values for left ovary ranged from 4 to 12 with an average of 5 3 + 2 04 It may also be seen that the total number of ovulation points on both the ovaries averaged 12 8 + 4 198 with a range of 2 to 27

The table also revealed that the number of unruptured follicles on the right ovary varied from 1 to 4 with an average of 1 5 ± 0 67 while in the left it ranged from 2 to 6 with a mean of 1 67 + 0 99 The average number of unruptured follicles on both the ovaries was 3 2 ± 1 58

The left ovary of one animal in this group was highly enlarged with multiple cystic follicles

Statistical analysis of the data revealed no significant difference in the two groups in the percentage of animals in oestrus after treatment the interval between

Fig 5 Group II Animal No I Superovulation with eCG and progesterone multiple ovulation points on the ovary

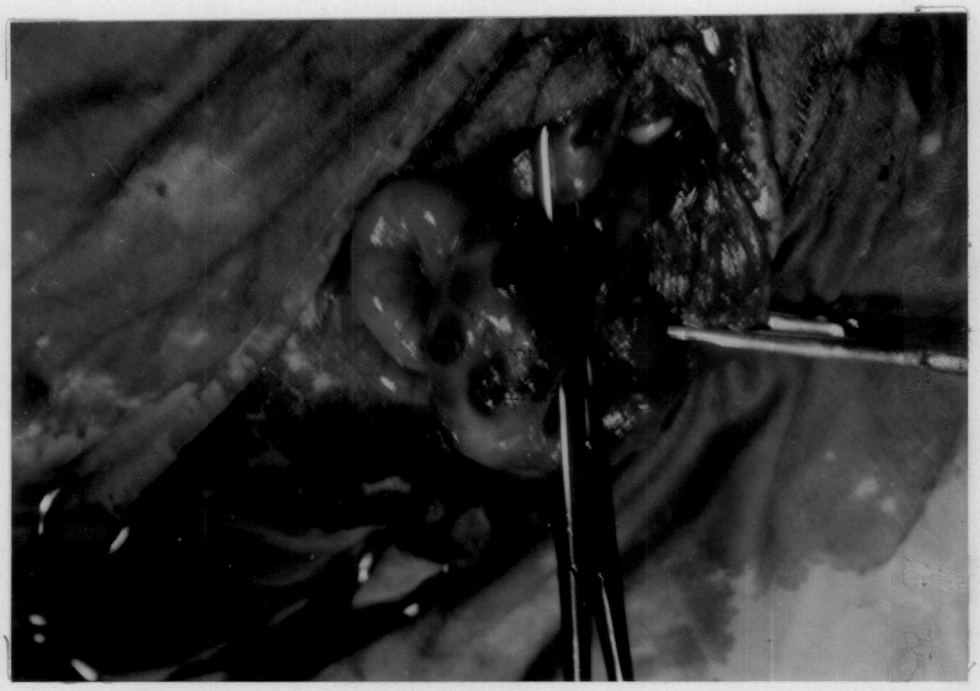


Fig 6 Group T Animal No II S e ith a
n cjesterone N e m n n
the ovary

the treatment and onset of oestrus and superovulato response after the treatment

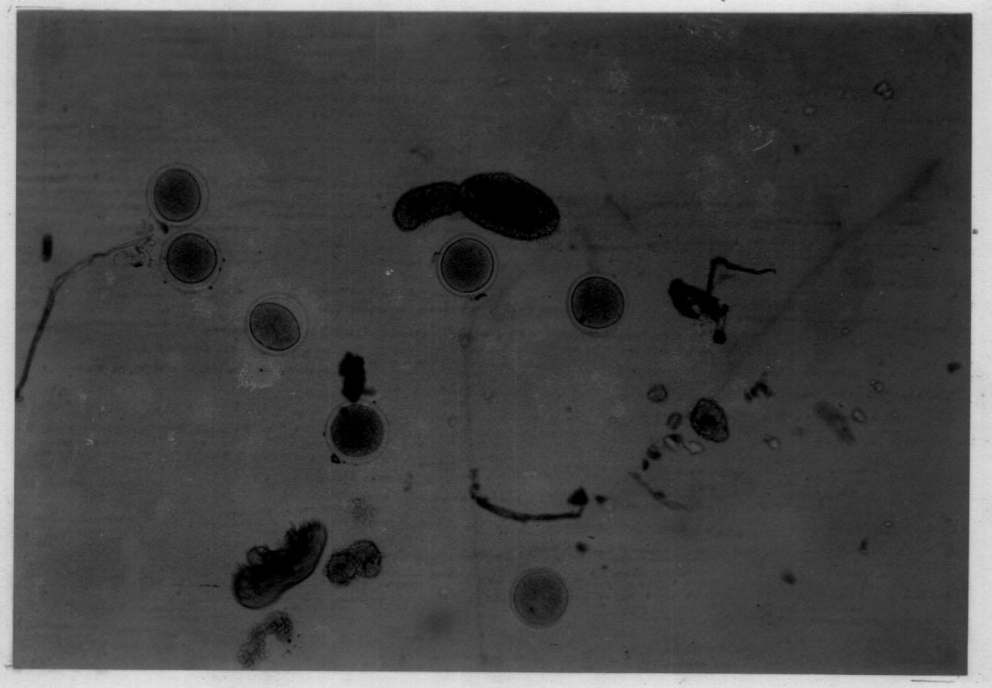
4 3 Embryo collection

4 3 1 Goats synchronised with prostaglandin

The result of embryo collection in animals superovulated with 1000 IU eCG on the day previous to the second dose of $PGF_{2\alpha}$ in the second treatment regime with two doses of 10 mg $PGF_{2\alpha}$ given 11 days apart is presented in Table 5 and Fig 7 It could be seen from the table that the number of embryos collected from the right ovary ranged fron 1 to 4 with an average of 2 2 + 0 66 while in the left ovary the values were 1 to 4 with a mean of 2 6 + 0 39 The total number of embryos on both the ovaries averaged 4 8 + 0 97 with a range of 2 to 8 The total number of embryos collected from all the animals in the right ovary was 11 (55%) of which 8 (72 72%) were transferable (mean 1 6) he total number of embryos collect d from all the animals in the left ovary was 13 (59 09%) of which 9 69 23%) we e transferable (mean 1 8) and 4 non transferable 30 76% It may also be seen that the total number of embryos collected from both the ovaries of all the animals was 24 57 14 % of which 17 (70 83 %) were transferable mean 3 4 and 7 no transferable (29 16 %)

hig roup l r ɯc ɾ a fror rəl o I

day 0)



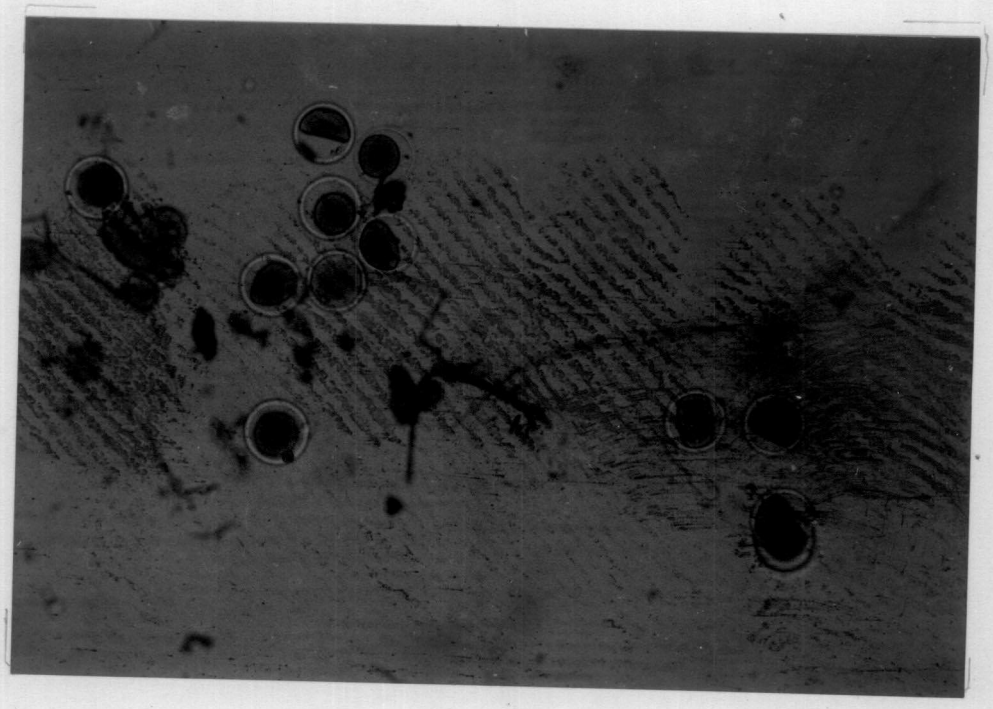
4 3 2 Goats synchronised with progesterone

The results of embryo collect on in a ima s superovulated with 1000 IU eCG on day 15 of secord t ea ren regime of 12 5 mg progesterone injection da ly fo 6 day are presented in table 6 and Fig 8 The number of emb vos collected from the right ovary varied from 1 to 11 w th a mean of 3 3 + 1 57 while from the left ovary the values were ranging from 2 to 9 with an average of 3 2 + 1 47 The total number of embryos on both the ovaries averaged 6 5 2 95 with a range of 1 to 20 The total number of embryos collected from all the animals in the right ovary was 20 (44 44%)of which 16 (80%) were transferable (mean 2 67 and 4 non transferable (20%) The total number of emb yos collected from all the animals in the left ovary was 19 (59 3%) of which 13 68 42% was transferable mean 2 17 and 6 non transferable (31 58%) It could also be observed that the total number of embryos collected from a l ne animals in both the ovaries was 39 (50 64% of wh ch 29 (74 36%)was transferable (mean 4 8) and 10 non transferable (25 64%)

Statistical analysis of the data revealed no significant difference between group I and group II in the response of right ovary left ovary and both the ovaries n relation to the number of ovulation po nts numbe of

ıg 3 ıo p y on Jo

ıday



unruptured follicles number of embryos collected and percentage of transferable and non transferable embryos collected

4 3 3 Control animals

The result of embryo collection from control animals is given in Table 7 It may be seen from the table that the average duration of oestrus was 33 7 ± 4 80 h with a range of 24 to 48 h The number of ovulation points in the right ovary ranged from zero to one with a mean of 0 5 ± 0 223 In the left ovary the values were zero to 1 with a mean of 0 33 + 0 210 It could also be seen that the total number of ovulation points on both the ovaries averaged 0 83 ± 0 166 with a range of zero to one It may also be seen that the number of unruptured follicles on both the ovaries was nil

The number of embryos collected from the right ovary ranged from zero to one with a mean of 0 33 ± 0 210 while in the left ovary the values ranged from zero to one with a mean of 0 33 ± 0 210 The total number of embryos collected from both the ovaries averaged 0 67 ± 0 21 with a range of zero to one

4 3 4 Quality of embryos

The quality of embryos collected in the two treatment groups and the control group is shown in table 8

It may be seen from the above table that the percentage of transferable embryos collected from animals in group I was 70 8 whereas in group II the percentage of transferable embryos was 74 4 In control animals 100 per cent were transferable

The effect of parity on superovulation of different animals are presented in Table 9 Sixteen embryos were collected from animals with parity of two and below (average 4) out of which 13 were transferable (81 3 %) In animals with parity of more than two 47 embryos were collected (average 6 7) out of which 33 were transferable (70 2 %)

The effect of age on superovulation is presented in table 10 Thirty ovulation points were observed in animals below 2 years (average 7 5) whereas in goats above 2 years 89 ovulation points were observed (average 12 7) The number of embryos collected was 16 and 47 with 13 and 33 transferable embryos respectively in the two groups

It may be noted that the percentage of animals evinced oestrus within 36 h of treatment in the two groups were 33 33 and zero with an overall percentage of 16 67 while those showed oestrus within 36 to 48 h were 33 33 % with an overall percentage of 33 33 Corresponding values for those showed oestrus after 48 h was 33 33 and 66 67 per cent with an overall percentage of 50 (Tab 11)

Data presented in Table 12 revealed that weak oestrus symptoms were observed in none of the animals subjected to superovulation where as medium symptoms were seen in 16 67 percentage of animals in group I with an overall percentage of 8 3 Intense oestrus symptoms were noted in 83 33 and 100 per cent of animals in group I and group II respectively with an overall percentage of 91 7

The details of flushing efficiency are presented in Table 13 Flushing was efficient in 83 33 66 67 and 100 per cent of animals in group I group II and control animals The overall efficiency percentage was 83 33

4 3 5 Embryo transfer

Embryo transfer was attempted in one goat by transferring one embryo each into the right and left uterine horns of the animal after conducting laparotomy as for

embryo collection But the animal did not conceive and returned to oestrus within two months However on subsequent breeding the animal conceived and kidded

4 3 6 Effect of embryo collection on subsequent fertility

Effect of embryo collection on subsequent oestrum of the animals in the three groups is consolidated in Table 14 Oestrum was noticed within two months in 50 66 67 and 50 per cent of the animals in group I group II and control animals respectively The overall percentage of animals showing oestrum within two months was 55 56 Oestrum was noticed within 2 to 3 months in 16 67 percent of animals in group I and control animals whereas none of the animals in group II showed oestrum during this period The overall percentage of animals showing oestrus within 2 to 3 months was 11 11 16 67% of animals in group I and group II and 33 33 % of animals in the control group showed oestrus after 3 months The overall percentage of animals showing oestrum after 3 months was 22

The details of conception rate of animals on subsequent breeding are presented in Table 15 The percentage of animals conceived was found to be 83 33% in group I and III and 66 7% in group II The overall percentage of conception was 77 8

Table 1

Effect of synchronisation using PGF_2 alpha

No of animal	Onset of oestrus after 2nd PG injection(h)	Duration of oestrus (h)	Intensity of oestrus
I	68	48	Intense
II	42	72	Intense
III	74	24	Medium
IV	68	72	Weak
V	44	48	Medium
VI	51	24	Medium
Mean ± SE	57 8±5 65h	48 0±8 76h	

Table 2

Effect of synchronisation using progesterone

No of animal	Onset of oestrus after last progesterone injection(h)	Duration of oestrus (h)	Intensity of oestrus
I	96	24	Intense
II	112	28	Medium
III	90	30	Intense
IV	120	32	Medium
V	--	-	-
VI	90	26	Medium
Mean ± SE	101 6±6 11h	28 0±1 41h	

Table 3

Superovulatory response in goats synchronised with PGF_2 alpha

No of animals	Interval after 2nd PG injection (h)	Duration of oestrus (h)	No of ovulation points			Unruptured follicles			Intensity of oestrus *
			Right	Left	Total	Right	Left	Total	
I	66	24	8	7	15	3	2	5	I
II	96	48	5	4	9	1	1	2	M
III**	36	48	-	-	-	6	7	13	I
IV	48	48	4	3	7	2	3	5	I
V	28	48	3	5	8	2	3	5	I
VI	28	48	Ovaro bursal adhesion	3	3	-	2	2	I
Mean ± SE	50 10 86	44 0± 4 0	4 0± 1 30	4 4± 0 7488	8 4± 1 94	2 3± 0 843	3 0± 0 987	5 3± 1 64	

* I - Intense
M - Medium

** Left ovary bigger than right with massive ovarian hyperstimulation with multiple cystic follicles on both the ovaries

Table 4

Superovulatory response in goats synchronised using progesterone

No of animals	Interval after last progesterone injection (h)	Duration of oestrus (h)	No of ovulation points			Unruptured follicles			Intensity of oestrus *
			Right	Left	Total	Right	Left	Total	
I	88hr	32hr	17	10	27	3	2	5	I
II	48hr	48hr	10	12	22	-			I
III	68hr	30hr	2	-	2	4	6	10	I
IV	96hr	48hr	8	6	14	-	-	-	I
V	44hr	24hr	6	4	10	1	2	3	I
VI	88hr	48hr	2	**	2	1	-	1	I
Mean ± SE	72 0± 9 06	38 3± 4 46	7 5± 2 31	5 3± 2 04	12 8± 4 19	1 5± 0 67	1 67± 0 99	3 2± 1 58	

* Intense

** Highly enlarged ovary with multiple cystic follicles

Table 5

Embryo collection in PGF_2 alpha synchronised group

No of animals	No of ovulation points			No of embryos collected			Percentage of embryos collected	No of transferable embryos collected			% of transferable embryos collected
	Right	Left	Total	Right	Left	Total		Right	Left	Total	
I	8	7	15	4	4	8	53 33	3	3	6	75
II	5	4	9	3	2	5	55 56	3	1	4	80
III*	-	-			-		-		-	-	-
IV	4	3	7	2	2	4	57 14	1	1	2	50
V	3	5	8	2	3	5	62 50	1	2	3	60
VI	**	3	3	-	2	2	66 67	-	2	2	100
Mean ± SE	4 ± 1 30	4 4 ± 0 748	8 4 ± 1 94	2 2 ± 0 66	2 6 ± 0 39	4 8 ± 0 97	57 14	1 6 ± 0 6	1 8 ± 0 38	3 4 ± 0 75	70 83

* Massive ovarian hyperstimulation with multiple cystic follicles

** Ovarobursal adhesion

Table 6

Embryo collection in progesterone synchronised group

No of animals	No of ovulation points			No of embryos collected			Percentage of embryos collected	No of transferable embryos collected			% of transferable embryos collected
	Right	Left	Total	Right	Left	Total		Right	Left	Total	
I	17	10	27	11	9	20	74 07	9	5	14	70
II	10	12	22	3	6	9	40 09	2	4	6	66 7
III	2	-	2	1	-	1	50 00	1	-	1	100
IV	8	6	14	2	2	4	28 57	1	2	3	75
V	6	4	10	2	2	4	40 00	2	2	4	100
VI	2	*	2	1	-	1	50 00	1	-	1	100
Mean ± SE	7 5 ± 2 31	5 3 ± 2 04	12 8 ± 4 198	3 3 ± 1 57	3 2 ± 1 47	6 5 ± 2 95	50 64	2 67 ± 1 28	2 17 ± 0 83	4 83 ± 1 98	74 36

* Highly enlarged ovary with multiple cystic follicles

Table 7

Embryo recovery from control group

No of animals	Duration of oestrus	No of ovulation points			No of embryos collected			% of embryos collected			Unruptured follicles			Intesnsity of oestrus *
		Right	Left	Total	Right	Left	Total	Right	Left	Total	Right	Left	Total	
I	34hr	1	-	1	1	-	1	100	-	100	-	-	-	I
II	24hr		1	1	-	1	1	-	100	100	-		-	I
III	24hr	1	-	1	-		-	-		-	-		-	M
IV	48hr	1	-	1	1		1	100	-	100	-	-	-	M
V	24hr	-	-	-	-			-	-		-		-	M
VI	48hr	-	1	1	-	1	1	-	100	100	-		-	M
Mean ±	33 7	0 5	0 33	0 83	0 33	0 33	0 67	33 3	33 3	66 7				
SE	4 8	+ 0 223	+ 0 21	+ 0 166	+ 0 21	+ 0 21	+ 0 21	+ 21 08	+ 21 08	+ 21 09				

* I Intense

M Medium

Table 8

Quality of embryos collected in the three groups

No of group	No of embryos collected			Transferable embryos			%	Non transferable embryos			%
	Right	Left	Total	Right	Left	Total		Right	Left	Total	
I	11	13	24	8	9	17	70 8	3	4	7	29 17
II	20	19	39	14	15	29	74 4	6	4	10	25 6
III	3	2	5	3	2	5	100 00	-	-		-

Table 9

Effect of parity on superovulation

Parity	No of Ovulation points *	No of embryos harvested	No of transferable embryos		No of Non transferable embryos	
			No	%	No	%
Two and below	30(4)	16	13	81 3	3	18 7
Above two	89(7)	47	33	70 2	14	29 8
Total	119(11)	63	46	73	17	27

* Number of animals is given in parenthesis

Table 10

Effect of age on superovulation

Age	No of Ovulation points	No of embryos harvested	No of transferable embryos		No of Non transferable embryos	
			No	%	No	%
Below 2Yr	30(4)	16	13	81 3	3	18 7
Above 2Yr	89(7)	47	33	70 2	14	29 8

Table 11

Effect of superovulation on onset of oestrus

Time for onset of oestrus	Groups		Overall %
	I	II	
In 36 hrs	2 (33 33%)		16 7
36 48 hrs	2 (33 33%)	2 (33 33%)	33 3
Above 48 hrs	2 (33 33%)	4 (66 67%)	50 00

Table 12

Effect of superovulation on intensity of oestrus

Intensity of oestrus (Symptom)	Group		Treatment group Mean
	I	II	
Weak	-	--	-
Medium	1 (16 67%)	-	8 3%
Intense	5 (83 33%)	6 (100 %)	91 7%

Table 13

Effect of superovulation on flushing efficiency

Flushing	Group I	Group II	Group III	Overall %
Efficient	5 (83 33%)	4 (66 67%)	6 100%	83 33
Difficult	1 (16 67)	2 (33 33%)	0 0	16 67

Table 14

Effect of embryo collection on subsequent oestrus

Oestrum	Groups			Overall %
	1	2	3	
Within 2 months	3 (50%)	4 (66 67%)	3 (50%)	55 56
2-3 Month	1 (16 67%)	-	1(16 67%)	11 11
Over 3 month	1 (16 67%)	1 (16 67%)	2 (33 33%)	22 22

Table 15

Effect of embryo collection on subsequent pregnancy

Pregnancy	Groups			Overall %
	1	2	3	
Pregnant within 6 months	5 (83 3)	4 (66 7)	5 (83 3)	77 8
Not Pregnant within 6 months	1 (16 67)	2 (33 3)	1 (16 67)	22 2

Discussion

DISCUSSION

With the object of evolving effective methods for standardising techniques for synchronisation of oestrus superovulation and collection of embryos 18 healthy goats were selected from the goat farm attached to the college of Veterinary and Animal Sciences Mannuthy and randomly allotted into three different groups with six animals in each Animals in the first group were given doses of 10 mg $PGF_{2\alpha}$ 11 days apart and those in the second group were given 12 5 mg progesterone injection daily for 16 days Six animals in the third group were kept as control The respective treatments were repeated in group I and II after a period of sixty days and superovulation in group I was carried out with eCG injection 1000 IU given intramuscularly on the day previous to the second dose of $PGF_{2\alpha}$ In group II superovulation was done by intramuscular injection of 1000 IU of eCG given on 15^{th} day of progesterone treatment All the animals in the above two groups and animals in the control group were inseminated with good quality buck semen four to six hours after the onset of oestrus and thereafter at 12 hour intervals till the end of oestrus Embryos were collected surgically in all the goats except one three days after the onset of oestrus by flushing the fallopian tube after conducting laparotomy of the inseminated goats on the

left flank The results obtained and inferences drawn are summarised below

5 1 Synchronisation of oestrus

5 1 1 Oestrus response after $PGF_{2\alpha}$ treatment

In the present study after the second injection of prostaglandin $F_{2\alpha}$ all the animals came to oestrus This is in agreement with the findings of Ott *et al* (1979) Westhuysen (1979) Pandey *et al* (1985) Greyling and Niekerk (1986) Pandiya and Rathor (1986) Mgongo (1987) and Ishwar and Pandey 1990 Ozsar *et al* (1987) observed an oestrus synchronisation percentage of 90 in a similar study However a lower oestrus synchronisation percentage of 80 to 85 was also reported by several workers (Perera *et al* 1978 D Urso and Dell Aquila 1981 and Kilicoglu *et al* 1985)

The mean interval between the second injection of $PGF_{2\alpha}$ and the onset of oestrus was 57 8 ± 5 65 h Westhuysen (1979) reported a time interval of 55 5 h from prostaglandin administration to the onset of oestrus Ott *et al* (1980) found the time interval between injection of $PGF_{2\alpha}$ and the onset of oestrus as 50 + 1 h D Urso and Dell Aquila (1981) observed 54 h as the time interval between $PGF_{2\alpha}$ administration and the onset of oestrus Greyling and

Neikerk (1986) obtained a mean interval of 55 3 h from treatment with cloprostenol to the onset of oestrus Ozsar *et al* (1987) observed that the period between injection of $PGF_{2\alpha}$ and the onset of oestrus was 50 0 ± 4 89 h after the second injection

A longer duration between prostaglandin injection and the onset of oestrus was reported by several workers also 113 3 ± 90 h (Pandey *et al* 1985) 68 h (Mgongo 1987) and 94 86 ± 21 12 h (Ishwar and Pandey 1990)

A shorter interval for the onset of oestrus after prostaglandin injection has also been reported 18 23 h (Perera *et al* 1978) 36 33 + 3 43 h (Pandiya and Rathor 1986) and 48 2 ± 15 7 h (Cox *et al* 1987)

5 1 2 Duration of oestrus

The results presented in Table 1 revealed that the mean oestrus duration after the second prostaglandin injection was 48 ± 8 76 h This was in accordance with Greyling and Niekerk (1986) and Pandiya and Rathor (1986) who reported average duration of oestrus following $PGF_{2\alpha}$ administration as 41 9 h and 44 ± 3 7 h respectively However Pandey *et al* (1985) observed that the duration of oestrus was only 16 0 + 1 6 h following $PGF_{2\alpha}$ treatment Ishwar and Pandey

(1991) also reported a shorter duration of oestrus (35 29 ± 3 09) following $PGF_{2\alpha}$ administration

5 1 3 Oestrus response after progesterone treatment

In the present study 83 33% of the animals were in oestrus after the last progesterone injection These findings concur with the results of earlier workers Welch and Tervit (1984) reported an oestrus synchronisation rate of 82% by using silicone elastomer progesterone dispensers for 18 days whereas Agrawal (1986) reported an oestrus synchronisation percentage of 82 14 after feeding melengestrol acetate for 16 days Agrawal (1987a) in another study had observed an oestrus synchronisation rate of 86 6% after progestogen feeding for 16 days Ozsar *et al* (1987) observed an oestrus synchronisation percentage of 80 with the use of a progestogen impregnated intravaginal sponge for 14 days Doijode *et al* (1991) also obtained a similar synchronisation rate of 85% following treatment with progesterone for 14 to 17 days

Kilicoglu *et al* (1985) observed an oestrus synchronisation rate of 96% following progestogen treatment whereas Kiessling *et al* (1986) observed 100% oestrus response with vaginal progesterone pessary therapy Agrawal (1987 b) found an oestrus synchronisation of 96 12% by

feeding melengestrol acetate for 16 days Indramani and Vadnere (1989) obtained an oestrus synchronisation rate of 100% using 12 mg progesterone injection whereas Ishwar and Pandey (1990) recorded an oestrus synchronisation rate of 90% using 12 5 mg progesterone injection for 16 days

Some workers have also reported a lower rate of synchronisation following progestogen treatment Westhuysen (1979) reported 75% oestrus synchronisation in goats using intravaginal progestogen sponge

The variation in response to synchronisation in various studies may be attributed to the drug used type of animal and time of administration of the drug

The mean interval between the last progesterone treatment and the onset of oestrus was 101 6 ± 6 11 h These findings are in general agreement with the reports of many workers Tervit (1981) using intravaginal sponges for 18 days found oestrus occurring at an overage of 2 4 days after sponge withdrawal Agrawal (1987 b) by feeding melengestrol acetate for 16 days reported oestrus within 4 days after treatment

Several other workers reported a shorter interval for the onset of oestrus using progesterone or progestogens for

synchronisation of oestrus which ranged from 24 to 84 h (Nishikawa *et al* 1963 b Moore and Eppleston 1979a Westhuysen 1979 Goold and Tervit 1982 Goold and Tervit 1984 Welch and Tervit 1984 Kiessling *et al* 1986 Ozsar *et al* 1987 and Doijode *et al* 1991)

In the present study it may be noted that progesterone was administered parenterally which would require more time to be eliminated from the body requiring more time for the initiation of oestrus Since the earlier workers used progesterone sponges or vaginal pessaries the chances of removal of exogenons progesterone would be quicker resulting in the resumption of cyclical activity at a quicker interval

5 1 4 Duration of Oestrus

The mean duration of oestrus after progesterone treatment was 28 ± 1 41 h which was almost similar to that of Doijode *et al* (1991) who reported an average duration of oestrus as 24 94 ± 0 78 h following progesterone treatment for 14 to 17 days However Nishikawa *et al* (1963b) Agrawal (1987 b) and Ishwar and Pandey (1990) observed higher duration of oestrus (33 12 to 72 h)

5 2 Superovulation

5 2 1 Oestrus response after treatment with eCG and $PGF_{2\alpha}$

The results of administration of eCG in the second treatment regime with $PGF_{2\alpha}$ (Table 3) revealed that all animals in this group evinced oestrus at a mean interval of 50 3 ± 10 86 h after the second injection of $PGF_{2\alpha}$ and the mean duration of oestrus was 44 + 4 h

Ott *et al* (1979) Armstrong and Evans (1983) Pandiya and Rathor (1986) Mahmood *et al* (1991) Ryot and Vadnere (1991) and Pandey *et al* (1992) also reported similarly with regard to oestrus synchronisation However a lower oestrus synchronisation (83 3%) was observed by Thilagar *et al* (1992) by using 7 5 mg $PGF_{2\alpha}$ 11 days apart and 1000 IU PMSG 24 h before the second dose of $PGF_{2\alpha}$

In the present study 50% of the animals were in oestrus 28 to 36 h after the second $PGF_{2\alpha}$ injection whereas the mean interval between administration of second dose of $PGF_{2\alpha}$ and onset of oestrus was 50 3 ± 10 86 h

Some workers have reported a shorter interval for the onset of oestrus after administration of PMSG and $PGF_{2\alpha}$ Ott *et al* (1979) found that by giving PMSG followed 48 h later by $PGF_{2\alpha}$ 100% of animals evinced oestrus within 36 h after

$PGF_{2\alpha}$ injection Armstrong and Evans (1983) reported that by using 750 1000 IU PMSG followed two days later by a prostaglandin analogue oestrus occurred 30 48h after the prostaglandin injection Elamvitayakorn *et al* (1988) observed an interval of 1 2 + 0 03 days between the onset of oestrus and injection of $PGF_{2\alpha}$ 48 to 72 h after giving 1000 IU PMSG Ryot and Vadnere (1991) observed 100% oestrus within 24 h after administering 1000 IU PMSG followed 24 h later 600 IU PMSG and 7 5 mg $PGF_{2\alpha}$ Thilagar *et al* (1992) reported a mean interval of 32 0 + 1 22 h between second $PGF_{2\alpha}$ injection and onset of oestrum

Elamvitayakorn *et al* (1988) and Pandey *et al* (1991) reported a shorter duration of oestrus of 1 3 ± 0 4 days and 18 66 ± 2 6 h respectively following administration of PMSG and $PGF_{2\alpha}$

The variation in the interval between the onset of oestrus and second $PGF_{2\alpha}$ injection and the duration of oestrus in different studies might be attributed to the variation in the interval between the PMSG injection and second $PGF_{2\alpha}$ injection Different doses of PMSG used in different studies would also have contributed to this

5 2 2 Superovulatory response after treatment with eCG and $PGF_{2\alpha}$

The results of administration of eCG and $PGF_{2\alpha}$ revealed that the total number of ovulation points on both the ovaries was 8 4 ± 1 94 with a value of 4 ± 1 30 for the right ovary and 4 4 ± 0 748 for the left ovary This is in accordance with that of earlier workers in a similar study

Armstrong and Evans (1983) observed an average ovulation rate of 10 8 ± 1 2 by using 750 1000 IU PMSG and a $PGF_{2\alpha}$ analogue 48 h later Pandiya and Rathor (1986) reported an average ovulation rate of 8 0 with 1500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ Pandey *et al* (1992) found an average ovulation rate of 9 8 by using 750 IU PMSG followed 5 mg $PGF_{2\alpha}$ 24 h later and 500 IU hCG on the day of oestrus

Several other workers have reported a higher ovulation following superovulation with PMSG Inderjeet and Gupta (1985) observed an average ovulation rate of 12 0 ± 2 49 with 1000 IU PMSG and 100 µg of a $PGF_{2\alpha}$ analogue 48 h later Mahmood *et al* (1991) recorded an average ovulation rate of 11 70 ± 8 07 by using 500 to 750 IU PMSG and a prostaglandin analogue 60 h later Ryot and Vadnere (1991) also observed a similar ovulation rate of 11 33 after giving 1000 IU PMSG

followed 24 h later by 600 IU PMSG and 7 5 mg $PGF_{2\alpha}$ and 1500 IU hCG on the day of oestrus On the contrary a lower ovulation rate of 6 8 was reported by Ott *et al* (1979) with 750 IU PMSG and 4 mg $PGF_{2\alpha}$ 48 h later Elamvitayakorn *et al* (1988) also observed a lower ovulation rate of 5 7 + 2 5 using 1000 IU PMSG and 10 mg $PGF_{2\alpha}$ 48 72 h later Thilagar *et al* (1992) found an ovulation rate of 2 67 by giving 500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ 24 h later

It could be seen from Table 3 that the total number of unruptured follicles on both the ovaries was 5 33 + 1 64 with a mean of 2 3 + 0 843 for the right ovary and 3 ± 0 987 for left ovary This finding is in general agreement with that of Pandiya and Rathor (1986) and Mahmood *et al* (1991) who have reported average unruptured follicles of 4 25 and 3 60 ± 2 67 respectively using PMSG and $PGF_{2\alpha}$ for superovulation

One experimental animal showed massive ovarian hyperstimulation with multiple cystic follicles (Fig 2 and 3) which subsequently was bred and kidded normally Armstrong and Evans (1983) also reported similar condition in an ewe which received an injection of 1500 2000 IU of PMSG which also was bred and lambed This condition might be attributed to the longer half life of PMSG

5 2 3 Oestrus response after treatment with eCG and progesterone

The results of administration of eCG and progesterone revealed that all the animals evinced oestrus 72 ± 9 06 h after the last progesterone injection and the duration of oestrus was 38 3 ± 4 46 h

Oestrus synchronisation rate of 100 % has also been reported earlier following treatment with eCG and progesterone (Aurstad and Gysler 1979 Moore and Eppleston 1979b Ahmed and Maurya 1981 Debenedetti and Lucaroni 1982 Goold and Tervit 1982 Goold and Tervit 1984 Kiessling *et al* 1986 Indramani and Vadnere 1989 Selgrath *et al* 1990 Ryot and Vadnere 1991 and Thilagar *et al* 1992)

A lower synchronisation rate of 89 5% was reported by Bongso *et al* (1982) using progestogen impregnated intravaginal sponges for 17 days and PMSG 300 IU on the day of sponge removal Agrawal (1986) observed synchronisation rate of 77 22% by administering melengestrol acetate for 16 days and PMSG 400 to 1000 IU on the last day of MGA feeding East and Rowe (1989) by using a vaginal sponge for 16 days and an injection of 250 IU PMSG 2 days before sponge removal observed 95 1% of animals in oestrus within 72 h of

sponge removal Doijode *et al* (1992a) found that after giving progesterone injection for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG 66 6% of the treated animals exhibited oestrus Pargaonkar *et al* (1992) also observed a lower rate of synchronisation of 87 5% following similar treatment This variation in the oestrus synchronisation rate in the different studies might be due to the different methods of synchronisation and superovulation

The mean interval between the last progesterone injection and onset of oestrus was 72 ± 9 06 h These results concur with the findings of several workers using eCG and progesterone for superovulation Goold and Tervit (1984) observed that using 12 mg progesterone for 17 days and PMSG on 16th day all the goats came to oestrus 2 9 days after the last progesterone injection East and Rowe (1989) found that using a vaginal sponge containing progestogen for 16 days and an injection of PMSG 2 days before sponge removal the female goats showed oestrus within 72 h of sponge removal Doijode *et al* (1992a) also reported that after injecting progesterone @ 12 5 mg/animal daily for 14 to 17 days and 1000 IU PMSG and 1500 IU hCG the animals exhibited oestrus within 76 62 + 20 98 h after the treatment

Several other workers (Aurstad and Gysler 1979 Moore and Eppleston 1979b Ahmed and Maurya 1981 Kiessling *et al* 1986 Goswami *et al* 1987 Indramani and Vadnere 1989 Selgrath *et al* 1990 Ryot and Vadnere 1991 and Thilagar *et al* 1992) reported a shorter interval for the onset of oestrus using eCG and progesterone which ranged from 24 to 60 h while longer interval between progesterone treatment and onset of oestrus was reported by other workers (Tervit 1981 Bongso *et al* 1982 Debenedetti and Lucaroni 1982 Agrawal 1986 and Pargaonkar *et al* 1992)

The duration of oestrus (38 3 ± 4 46 h) is in agreement with the findings of Pargaonkar *et al* (1992) using progesterone and PMSG although Dojode *et al* (1992b) observed a shorter duration of oestrus of 22 5 ± 0 23 h following similar treatment

5 2 4 Superovulatory response after treatment with eCG and progesterone

In the present investigation the total number of ovulation points on both the ovaries was 12 8 ± 1 4 with a value of 7 5 + 2 31 for the right ovary and 5 3 ± 2 04 for the left ovary The present value is in agreement with the findings of several workers using progesterone and eCG for superovulation Moore and Eppleston (1979b) observed an

average ovulation rate of 13 7 + 2 2 in goats treated with 1500 IU PMSG given at the end of a progesterone treatment of 12 mg/day An ovulation rate of 12 54 was obtained by Ahmed and Maurya (1981) by giving progesterone followed by PMSG and hCG Goold and Tervit (1982) found an ovulation rate of 9 9 with 12 mg progesterone for 17 days and PMSG on the 16th day Indramani and Vadnere (1989) reported an average ovulation rate of 10 62 by using 1000 IU PMSG given 24 h after withdrawal of a progesterone therapy of 12 mg for seven days and 400 IU PMSG on the following day and 1000 IU chorionic gonadotrophin given 12 h after the onset of oestrum

Lower values ranging from 3 00 to 9 42 (Van rensburg 1964 Suh *et al* 1975 Tervit 1981 Agrawal 1982 Goold and Tervit 1984 Agrawal 1986 Kiessling *et al* 1986 Selgrath *et al* 1990 Dojode *et al* 1992a Pargaonkar *et al* 1992 and Thilagar *et al* 1992) and higher values 16 33 (Ryot and Vadnere 1991) have also been reported following superovulation using eCG and progesterone

It could be seen from Table 4 that the total number of unruptured follicles on both the ovaries was 3 2 ± 1 579 with a mean of 1 5 ± 0 671 for right ovary and 1 67 + 0 995 for left ovary Indramani and Vadnere (1989) also reported an average unruptured follicle rate of 3 25 by using 1000 IU

PMSG given 24 h after a progesterone therapy for seven days and 400 IU PMSG given on the following day and 1000 IU hCG given 12 h after the onset of oestrum On the other hand Doijode *et al* (1992a) observed 6 62 ± 1 34 unruptured follicles after giving progesterone for 14 to 17 days followed by 1000 IU PMSG and 1500 IU hCG But Pargaonkar *et al* (1992) reported only 1 85 ± 0 06 unruptured follicles after administering progesterone @ 12 5 mg/animal for 14 16 days and 1000 IU PMSG given on 13 15 days and 1500 IU hCG on the day of oestrus These variations in different studies might also be attributed to the different treatment regime and drugs used in the respective trials

5 3 Embryo collection

5 3 1 Goats synchronised with prostaglandin

Perusal of the data presented in Table 5 revealed that the average number of embryos collected from both the ovaries was 4 8 ± 0 71 with a mean value of 2 2 ± 0 4 for the right ovary and 2 6 ± 0 51 for the left ovary The total number of embryos collected from all the animals in both the ovaries was 24 (57 14%) of which 17 (70 83%) were transferable and 7 (29 16%) non transferable The total number of embryos collected from all the animals in the right ovary was 11 (55%) of which 8 (72 72%) was transferable and 3 (27 28%) was non transferable whereas the

total number of embryos collected from all the animals in the left ovary was 13 (59 09%) of which 9 (69 23%) was transferrable and 4 (30 76%) non transferrable

These results of embryo collection and percentage of embryo recovery are in full agreement with the observations of several workers following $PGF_{2\alpha}$ and eCG administration for superovulation in goats Pandiya and Rathor (1986) observed a mean embryo recovery rate of 4 75 and embryo recovery percentage of of 59 37 using 1500 IU PMSG and 7 5 mg $PGF_{2\alpha}$ Tsunoda and Sugie (1989) obtained an average of 5 7 ± 4 4 embryos per female using PMSG for superovulation and $PGF_{2\alpha}$ for synchronisation Pandey *et al* (1992) reported an average embryo recovery rate of 5 3 and percentage embryo recovery of 61 53 following administration of 750 IU PMSG 3 mg $PGF_{2\alpha}$ 24 h later and 500 IU hCG on the day of oestrus Thilagar *et al* (1992) found a mean embryo recovery percentage of 62 following PMSG and $PGF_{2\alpha}$ injection

A higher embryo recovery rate following PMSG and $PGF_{2\alpha}$ administration has also been reported Armstrong and Evans (1983) observed 7 9 ± 1 2 embryo recovery following injection of 750 1000 IU PMSG and a $PGF_{2\alpha}$ analogue 2 days later Inderjeet and Gupta (1985) observed 75 to 80 embryo recovery percentage using 1000 IU PMSG followed by 100 µg of

a $PGF_{2\alpha}$ analogue Na *et al* (1987) found an embryo recovery percentage of 76 67 with an injection of 1000 IU PMSG given an goats synchronised with $PGF_{2\alpha}$ Ryot and Vadnere (1991) obtained a recovery rate of 8 0 with 70 59 as percentage of embryo recovery when PMSG was administered followed by $PGF_{2\alpha}$ and hCG

A lower embryo recovery rate of 2 5 ± 5 02 was observed by Mahmood *et al* (1991) by giving 500 IU to 750 IU PMSG followed 60 h later by a $PGF_{2\alpha}$ analogue injection In indigenous goats Thilagar *et al* (1992) obtained an average recovery rate of 1 67 when synchronised with $PGF_{2\alpha}$ and superovulated with PMSG

5 3 2 Goats synchronised with progesterone

Data presented in Table 6 shows that the average number of embryos collected from both the ovaries was 6 5 ± 2 95 with a mean value of 3 3 ± 1 57 for the right ovary and 3 2 ± 1 47 for the left ovary The total number of embryos collected from all the animals in both the ovaries was 39 (50 64%) of which 29 (74 36%) were transferrable and 10 (25 64%) non transferrable The total number of embryos collected from all the animals in the right ovary was 20(44 44%) of which 16 (80%) were transferrable and 4 (20%) non transferrable whereas the total number of embryos

an average fertilised ova recovery rate of 6 0 following

collected from all the animals in the left ovary was 19 (59 3%) of which 13 (68 42%) was transferrable and 6 (31 58%) non transferrable

These results concur with the findings of earlier workers when progesterone and eCG were used for superovulation in goats Tervit (1981) observed an average fertilised egg recovery of 5 8 in female Angora goats treated with 12 mg progesterone for 17 days and PMSG on day 16 to induce superovulation Agrawal et al (1982) observed 52 7% of embryo recovery in female goats synchronised by feeding melengestrol acetate for 16 days and superovulated with an injection of PMSG on the last day of feeding Goold and Tervit (1982) obtained an average fertilised ova recovery of 6 7 by giving progesterone injection for 17 days and PMSG on 16 th day The same authors in another study (Goold and Tervit 1984) observed an average fertilised ova recovery rate of 6 0 following administration of progesterone and PMSG Ryot and Vadnere (1991) found a total ova recovery rate of 59 18 by giving progesterone injection followed by PMSG and hCG

Some other workers have also reported a higher rate of embryo collection and percentage of embryo recovery with progesterone and eCG administration Ahmed and Maurya (1981) reported an embryo recovery rate of 77 41% in goats treated

with progesterone injection for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating Ryot and Vadnere (1991) observed a total ova recovery rate of 9 67 with progesterone injection followed by PMSG and hCG Pargaonkar et al (1992) reported that progesterone injection followed by PMSG and hCG resulted in a mean ova recovery rate of 7 42 + 1 73 and over all mean percentage of fertilised ova of 86 5 ± 5 0

A lower rate of embryo collection (4 25) was observed by Agrawal et al (1983) in goats treated with PMSG on the last day of feeding melengestrol acetate Kiessling et al (1986) found an average embryo recovery rate of 2 + 2 by using PMSG (20 IU/Kg body wt) on day 17 of the 18 20 day vaginal progesterone pessary treatment Selgrath et al (1990) observed a total ova recovery rate of 3 6 + 3 4 in goats treated with 1000 IU PMSG 24 h prior to the removal of a progestogen ear implant maintained for 14 to 21 days Dojjode et al (1992a) found an average egg recovery rate of 0 875 by administering progesterone injection followed by 1000 IU PMSG and 1500 IU hCG Thilagar et al (1992) noted an average egg recovery rate of 2 67 by injecting 500 IU PMSG 24 h before removal of an ear implant maintained for 11 days

Even though a marginal increase in the average number of embryos collected were observed in the progesterone synchronised goats the percentage of embryo recovery showed a declining trend At the same time it could also be noted that the percentage of embryo recovery was more when $PGF_{2\alpha}$ was used for synchronisation It could therefore be possible that when the superovulatory response was more there was a corresponding decrease in the rate of embryo recovery

5 3 3 Embryo collection in control animals

In control animals the total number of ovulation points on both the ovaries averaged 0 83 ± 0 166 with a value of 0 5 + 0 223 for the right ovary and 0 33 ± 0 210 for the left ovary The total number of embryos collected from both the ovaries averaged 0 67 + 0 21 The present observation is lower compared to the results published by Westhuysen (1979) who found an average ovulation rate of 1 5 Ott et al (1980) Agrawal (1986) and Kiessling et al (1986) also reported a similar trend

5 3 4 Quality of embryos collected

It could be seen from Table 8 that the percentage of transferable embryos collected from animals synchronised

using prostaglandin was 70 8 whereas in those goats synchronised using progesterone the percentage of transferable embryos was 74 4 In control animals 100% of the embryos ollected were of transferrable quality These observations are in general agreement with the results of Inderjeet and Gupta (1985) and Ryot and Vadnere (1991) when $PGF_{2\alpha}$ was used for synchronisation and Suh et al (1975) and Ryot and Vadnere (1991) when progesterone was used for synchronisation

A higher rate of fertilisation of recovered ova (81 97%) was reported by Ahmed and Maurya (1981) when treated with progesterone for 6 14 days followed by 1000 IU PMSG 24 h after the end of progesterone treatment and 400 IU PMSG 24 h later and 1000 IU hCG given immediately before mating Similarly Agrawal et al (1982) observed 85% of fertilised ova when fed with melengestrol acetate for 16 days and superovulated with an injection of PMSG on the last day of melengestrol acetate feeding

A lower rate of fertilisation of ova was reported by Moore and Eppleston (1979b) when PMSG was given to a group of progesterone synchronised goats A similar trend was also reported by Dorjode et al (1992a)

The present study revealed that age and parity did not influence the average number of ovulation points and number of embryos collected

5 3 5 Embryo transfer

In the present study although embryo transfer was attempted in one goat by transferring one embryo each into left and right uterine horn after conducting laparotomy the animal did not conceive Since the number of animals in which embryo was transferred was limited to one a conclusive proof on the success of this technique could not be judged

5 3 6 Effect of embryo collection on subsequent fertility

Results of the present study also revealed that there is no significant variation on subsequent oestrum or fertility between experimental and control animals indicating that superovulation and embryo collection did not affect adversely the future reproductive performance

It can be concluded that synchronisation and superovulation using prostaglandin and progesterone and eCG can be adapted effectively as a practical method for multiple ovulation and embryo transfer technique in goats

However more trials using large number of goats are warranted

Summary

SUMMARY

With the aim of evolving effective methods for standardising techniques for synchronisation of oestrus superovulation and collection of embryos 18 healthy goats were selected from the goat farm attached to the College of Veterinary and Animal Sciences Mannuthy and randomly divided into three different groups with six animals each Animals in the first group were given two doses of 10 mg $PGF_{2\alpha}$ 11 days apart and those in the second group were given 12 5 mg progesterone injection daily for 16 days Six animals in the third group were not given any treatment and kept as control

The respective treatments were repeated in group I and II after a period of sixty days and superovulation in group I was carried out with eCG injection 1000 IU given intramuscularly on the day previous to the second dose of $PGF_{2\alpha}$ In group II superovulation was done by intramuscular injection of 1000 IU of eCG given on the 15 th day of progesterone treatment All the animals in the above two groups and animals in the control group were inseminated with good quality buck semen four to six hours after the onset of oestrus and thereafter at 12 hour intervals till the end of oestrus Embryos were collected surgically in all

the eighteen goats by flushing the fallopian tube towards the fimbria after conducting laparotomy on the left flank

Synchronisation of oestrus

All the animals in group I came to oestrus 57 8 ± 5 65h after the second injection of $PGF_{2\alpha}$ The average duration of oestrus was 48 ± 8 76 h

In group II 83 33% were in oestrus at an interval of 101 6 ± 6 11 h after the last progesterone injection and the duration of oestrus was 28 ± 1 41 h

Superovulation

The results of administration of eCG in the second treatment regime with $PGF_{2\alpha}$ revealed that all animals in group I evinced oestrus at a mean interval of 50 3 ± 10 86 h after the second injection of $PGF_{2\alpha}$ and the mean duration of oestrus was 44 + 4 h

The total number of ovulation points on both the ovaries was 8 4 ± 1 94 with 4 + 1 30 and 4 4 ± 0 748 for the right and left ovaries respectively The total number of unruptured follicles on both the ovaries was 5 33 ± 1 64

with a mean of 2 3 ± 0 843 for the right and 3 ± 0 987 for the left ovary respectively

The animals in group II after administration of eCG and progesterone evinced oestrus 72 ± 9 06 h after the last progesterone injection with the duration of oestrus of 38 3 ± 4 46h The total number of ovulation points on both the ovaries was 12 8 ± 1 4 with 7 5 ± 2 31 for the right and 5 3 ± 2 04 for the left ovary respectively The total number of unruptured follicles on both the ovaries was 3 2 + 1 579

Statistical analysis revealed no significant difference in the percentage of animals in oestrus after treatment the interval between the treatment and onset of oestrus and superovulatory response in the two groups

Embryo collection

The results of embryo collection in animals in group I revealed that the average number of embryos collected from both the ovaries was 4 8 ± 0 97 with 2 2 + 0 66 for the right and 2 6 ± 0 39 for the left ovary The total number of embryos collected from all the animals in both ovaries was 24(57 14%) of which 17 (70 83%) were transferrable and 7 (29 16%) non transferrable The total number of embryos collected from all the animals in the right ovary was 11

(55%) of which 8 (72 72%) was transferrable and 3 (27 28%) non transferrable whereas the total number of embryos collected from all the animals in the left ovary was 13 (59 09%) of which 9 (69 23%) was transferrable and 4 (30 76%) non transferrable

The results of embryo collection in animals of group II showed that the average number of embryos collected from both the ovaries was 6 5 ± 2 95 with a mean value of 3 3 ± 1 57 for the right and 3 2 ± 1 47 for the left ovary The total number of embryos collected from all the animals in both the ovaries was 39 (50 64%) of which 29 (74 36%) were transferrable and 10 (25 64%) non transferrable The total number of embryos collected from all the animals in the right ovary was 20 (44 44%)of which 16 (80%) were transferrable and 4 (20%) non transferrable whereas the total number of embryos collected from all the animals in the left ovary was 19 (59 3%) of which 13 (68 42%) were transferrable

Even though a marginal increase in the average number of embryos collected were observed in the progesterone synchronised goats the percentage of embryo recovery showed a declining trend At the same time it could also be noted that the percentage of embryo recovery was more when $PGF_{2\alpha}$ was used for synchronisation It could therefore be

possible that when the superovulatory response was more there was a corresponding decrease in the rate of embryo recovery

In control animals the total number of ovulation points on both the ovaries averaged 0 83 ± 0 166 with a value of 0 5 ± 0 223 for the right and 0 33 ± 0 210 for the left ovary The total number of embryos collected from both the ovaries averaged 0 67 ± 0 21

The percentage of transferrable embryos collected from animals in group I and II was 70 8 and 74 4 respectively whereas in control animals 100% were transferrable

Parity and age were found to have no influence on the average number of ovulation points and number of embryos collected

Although transfer of embryo was attempted in one goat by transferring one embryo each into right and left uterine horn after conducting laparotomy the animal did not conceive Since the number of animals in which embryo was transferred was limited to one a conclusive proof on the success of this technique could not be judged

No significant variation could be observed on subsequent oestrus or fertility between the experimental and control animals indicating that synchronisation and superovulation using prostaglandin and progesterone and eCG can be adopted as a practical method for multiple ovulation and embryo transfer technique in goats

References

REFERENCES

Agrawal K P (1987a) Hormonal ınductıon of oestrus ın anoestrus (acyclıc) does *Indıan Vet Medıcal J* 11(2) 115 116

Agrawal K P (1987b) Studıes on embryo transfer ın ındıgenous goats under tropıcal clımate synchronızatıon of oestrus by melengestrol acetate *Indıan J Anım Repord* 8 (2) 129 132

Agrawal K P Mongha I V and Bhattacharya N K (1982) Collectıon and transfer of embryo ın goats surgıcal method *Indıan Vet J* 59 (4) 298 303

———

Agrawal K P (1986) Hormonal control of ovulatıon and ınductıon of superovulatıon ın Barbarı goats used as donors ın embryo transplantatıon studıes *Indıan J Anım Reprod* 7 (1) 81 83

Agrawal K P Mongha L V and Bhattacharya N K (1983) Survıval of goat embryos ın rabbıt ovıduct *Vet Rec* 112 (9) 200

Ahmed T and Maurya S N (1981) Multıple ovulatıon ın and recovery of eggs from goats *Acta vet hung* 29

(4) 471 475 cited in *Anim Breed Abstr* (1983) 51(10) No 6081

Armstrong D T and Evans G (1983) Factors influencing success of embryo transfer in sheep and goats *Theriogenology* 19 (1) 31 42

Arthur G H Noakes D E and Pearson H (1989a) *Veterinary Reproduction and Obstetrics* Balliere Tindall London 6th Ed

Arthur G H Noakes D E and Pearson H (1989b) *Veterinary Reproduction and Obstetrics* Balliere Tindall London 6th Ed

Aurstad J F and Gysler K (1979) A field study of oestrus synchronisation in goats by means of medroxy progesterone acetate (MAP Perlutex Leo) and serum gonadotropin (PMSG Antex Leo) *Norsk VetTidsskr* 91 (9) 515 519 cited in *Anim Breed Abstr* (1980) 48 (9) No 5397

Bongso T A Fatimah I and Dass S (1982) Synchronisation of oestrus of goats treated with progestagen impreganted intravaginal sponges and PMSG and

reproductive performance following a natural mating or A I with fozen semen *Anim Reprod Sci* 2 (5) 111 116

Bosu W T K Serna J and Barker C A V (1978) Peripheral plasma levels of progesterone in goats treated with fluorogestone acetate and prostaglandin $F_{2\alpha}$ during the oestrous cycle *Theriogenology* 9 (4) 371 390

Bretzlaff K N Hill A and Ott R S (1983) Induction of luteolysis in goats with prostaglandin $F_{2\alpha}$ *Am J Vet Res* 44 (6) 1162 1164

Costa S A da Franca M P and Vinha N A (1982) Artificial insemination of indigenous goats with frozen semen following oestrus synchronization with $PGF_{2\alpha}$ *Archos Esc Vet Minas Gerais* 34 (2) 273 277

Cox J F Santa Maria A Rodriguez R and Islas A (1987) Oestrus synchronization in Criollo goats by means of Tiaprost Determination of the luteolytic dose *Agro Ciencia* 3 (2) 167 168 cited in *Vet Bull* (1990) 60 (8) No 5921

Debenedettı A and Lucaronı A (1982) Inductıon and synchronısatıon of oestrus ın goats by means of a subcutaneous progesterone ımplant prelımınary results *Attı Soc ıtal Scı vet* 32 261 cıted ın *Anım Breed Abstr* (1982) 50 (11) No 6315

Doıjode S V Bakshı S A Pargaonkar D R and Markandeya N M (1991) Studıes on synchronızatıon of oestrus ın does *Indıan J Anım Reprod* 12 (2) 185 187

Doıjode S V Bakshı S A Pargaonkar D R and Markandeya N M (1992a) Synchronısatıon of oestrus superovulatıon and recovery of embryos ın Osmanabadı and crossbred goats *Pre conference proceedıngs asbstracts of contrıbutory papers Vol I V Internatıonal conference on goats ın Indıa* 335

Doıjode S V Bakshı S A Tandle M K and Mamde C S (1992b) Studıes on superovulatıon and recovery of embryos ın goats treated as donors *Indıan J Anım Repord* 13 (2) 192 194

D Urso G and Dell Aquila S (1981) Use of prostaglandin $F_{2\alpha}$ for oestrus synchronization in goats *Zootec Nutri Anim* 7 (3) 193 197 cited in *Anim Breed Abstr* (1983) 51 (8) No 5013

East N E and Rowe J D (1989) Subcutaneous projestin implants versus intravaginal sponges for dairy goat oestrus sychronisation during the transitional period *Theriogenology* 32 (6) 921 928

Elamvitayakorn J Natural N G and Apelo C L (1988) Superovulatory treatment in goats (*Capra hircus*) *Thai J Vet Med* 18 (3) 251 258 cited in *Anim Breed Abstr* (1990) 58 (10) No 6692

Goold P G and Tervit H R (1982) Embryo transfer in Angora goats *Annual Report 1980 81 Newzeland Ministry of Agriculture and Fisheries* p 45 cited in *Anim Breed Abstr* (1982) 50 (11) No 5918

Goold P G and Tervit H R (1984) Embryo transfer in Angroa goats *Annual Report 1982 83 NewZealand Ministry of Agriculture and Fisheries* p 61

Cited in *Anim Breed Abstr* (1984) 52 (7) No 4046

Goswami J Dutta J C and Buragohain S K (1987) Induction of oestrus in local goat (*Capra hircus*) of Assam *Indian J Anim Reprod* 8 (1) 65

Greyling J P C and Niekerk C H van (1986) Synchronization of oestrus in the Boer goat doe dose effect of prostaglandin in the double injection *S Afr J Anim Sci* 16 (3) 146 150 Cited in *Anim Breed Abstr* (1987) 55 (1) No 297

Inderjeet and Gupta R C (1985) Studies on superovulation and morphological evlauation of embryos in goats *Indian J Anim Reprod* 6 (2) 174

Indramani and Vadnere S V (1989) Superovulation and synchronization of oestrus in goats *Indian J Anim Repro* 10 (1) 46 48

Ishwar A K and Pandey J N (1990) Estrus synchronization and fertility behaviour in Black Bengal goats following either progesterone or prostaglandin treatment *Theriogenology* 34 (5) 1015 1024

Kiessling A A Hughes W H and Blankevoort M R (1986) Superovulation and embryo transfer in the dairy goat *J Am Vet Med Assoc* 188 (8) 829 832

Kilicoglu C Alacam E Izgur H Askin Y Ozsar s and Arif S (1985) Oestrus synchronization in dairy goats using dinoprost tromethamine (PG) and medroxy progesterone acetate (MAP) *Vet Fak Derg Ankara Univ* 32 (1) 187 199 cited in *Anim Breed Abstr* (1986) 54 (6) No 3869

Mahmood S Koul G L and Biswas J C (1991) Comparative efficacy of FSH P and PMSG on superovulation in Pashmina goats *Theriogenology* 35 (6) 1191 1196

Mgongo F O K (1987) Doses of prostaglandin analogue Cloprostenol by intravulvo submucosal (IVSM) injections effective for the induction of oestrus in goats *Anim Reprod Sci* 14 (2) 139 146

Moore N W and Appleton J (1988) The control of oestrus ovulation and fertility in relation to artificial insemination in the Angora goat *Australian J Agri Res* 30 (5) 965 972

Moore N W and Eppleston J (1979b) Embryo transfer in the Angora goat *Australian J Agri Res* 30 (5) 973 981

Na J S Kim Y S and Kang B K (1987) Embryo transfer in Korean native goats *Korean J Anim Sci* 29 (7) 295 302 cited in *Anim Breed Abstr* (1988) 56 (1) No 256

Nishikawa Y Horie T and Onuma H (1963a) Studies on the transplantation of Ova (artificial pregnancy) in goats II experiments on a method of inducing ovulation of artificially developed follicles and oestrus in treated animals *Proc Japan Acad* 39 610 615 Cited in *Anim Breed Abstr* (1964) 32 (3) No 2148

Nishakawa Y Horie T Sugie T Onuma H and Niwa T (1963b) Studies on transplantation of ova (artificial preganancy) in goats III Experiments on the speed of ova descending the genital tract progress of cleavage of ova and collection of ova from the donor IV Experiments on synchronisation of oestrus and transplantation of ova into the recipient *Proc Japan Acad* 39 671

676 758 763 cited in *Anim Breed Abstr* (1964) 32 (3) No 2149

Ott R S Nelson D R Lock T F and Hixon J E (1979) The effect of two levels of PMSG on ovulation in goats *Theriogenology* 11 (1) 105

Ott R S Nelson D R and Hixon J E (1980) Peripheral serum progesterone and luteinizing hormone concentrations of goats during synchronization of oestrus and ovulation with prostaglandin $F_{2\alpha}$ *Am J Vet Res* 41 (9) 1432 1434

Ozsar S Guven B Ekici A Arif S and Emre Z (1987) Control of ovarian function in the Angora goat during the transition period from anoestrus to estrus Artificial insemination and fertility control *Doga Veterinerlik ve Hayvancilik* 11 (2) 155 162 Cited in *Anim Breed Abstr* (1987) 55 (12) No 7704

Pandey J N Ishwar A K and Singh R A (1985) Ostrus synchronization in goats using prostaglandin (Lutalyse) *Indian J Anim Sci* 55 (7) 551 552

Pandey A Sinha S K Mishra O P and Pandey J N (1991) Synchronisation of oestrus of Black Bengal goats following administration of $PGF_{2\alpha}$ and gonadotrophins *J Res Bisra Agri Univ* 3 (1) 109 110

Pandey A Sinha S K Mishra O P and Pandey J N (1992) Superovulation and embryo recovery in Black Bengal goats *Indian J Anim Reprod* 13 (1) 25 27

Pandiya S C and Rathor S S (1986) Embryo transfer in goats *Indian Vet J* 63 (1) 34 36

Pargaonkar M Bakshi S A Pargaonkar D R Tandle M K and Salunke V M (1992) Studies on superovulatory response and surgical embryo recovery in goats *Indian J Anim Reprod* 13 (1) 23 25

Perera B M A Bongso T A and Abeynaike P (1978) Oestrus synchronisation in goats using cloprostenol *Vet Rec* 102 (14) 314

Ryot K D and Vadnere S V (1991) Superovulatory response to two hormonal regimens in non descript goats *Indian J Anim Reprod* 12 (2) 189 191

Selgrath J P Memon M A Smith T E and Ebert K M (1990) Collection and transfer of microinjectable embryos from dairy goats *Theriogenology* 34 (6) 1195 1205

Snedecor G W and Cochran W G (1967) *Statistical Methods* Oxford and IBH New Delhi 6th Ed

Suh G S Kim J K Shin W J Im I S Sul D S and Lee Y B (1975) Studies on egg transfer in goats *Research Reports of the office of Rural Development Suwon* 17 (8) 21 32 cited in *Anim Breed Abstr* (1977) 45 (11) No 6638

Tervit H R (1981) Egg transfer in goats *Annual Report 1979 80 Newzealand Ministry of Agriculature and Fisheries* P 80 81 cited in *Anim Breed Abstr* (1982) 50 (4) No 1765

Thilagar S Kathiresan D Padmanaban V D and Mohammed M S D (1992) A comparison of two hormonal treatments on oestrus synchronization and embryo

recovery in indigenous goats *Pre conference proceedings abstracts of contributory papers Vol I V International conference on goats in India* 374

Tsunoda Y and Sugie T (1989) Superovulation in non seasonal Japanese native goats with special reference to the developmental progression of embryos *Theriogenology* 31 (5) 991 996

Van rensburg S M (1964) Ovum Production action of various gonadotropins in sheep and goats *Onderstepoort J Vet Res* 31 97 106 cited in *Anim Breed Abstr* (1965) 33 (1) No 446

Wani G M Geldermann H and Hahn J (1985) Oestrus synchronization in goats *Zuchthygiene* 20 (5) 247 250 cited in *Anim Breed Abstr* (1986) 54 (4) No 2254

Warwick B L and Berry R O (1949) Intergeneric and intraspecific embryo transfer *J Hered* 40 297 303

Welch R A and Tervit H R (1984) Artificial insemination of goats comparison of oestrus control with CIDR

dispensers and sponges *Annual Report 1982 83 Newzealand Ministery of Agriculture and Fisheries* 64 65 cited in *Anim Breed Abstr* (1984) 52 (7) No 4051

Westhuysen J M Van der (1979) The control of ovarian function in cycling and anoestrous Angora goat does *Agroanimalia* 11 (2) 23 25 Cited in *Anim Breed Abstr* (1980) 48 (5) No 2567

Zanwar S G (1981) Embryo transfer in sheep *Indian J Anim Reprod* 1 34 36

SYNCHRONISATION OF OESTRUS, SUPEROVULATION AND EMBRYO COLLECTION IN GOATS

By

BENJAMIN. E. D.

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Reproduction
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy Thrissur

1994

ABSTRACT

With the object of evolving effective methods for standardising techniques for synchronisation of oestrus superovulation and collection of embryos 18 healthy goats were selected from the goat farm attached to the College of Veterinary and Animal Sciences Mannuthy and randomly divided into three different groups with six animals in each Animals in the first group were given two doses of 10 mg $PGF_{2\alpha}$ 11 days apart and those in the second group were given 12 5 mg progesterone injection daily for 16 days Six animals in the third group were not given any treatment and kept as control

The respective treatments were repeated in group I and II after a period of sixty days and superovulation in group I was carried out with eCG injection 1000 IU given intramuscularly on the day previous to the second dose of $PGF_{2\alpha}$ In group II superovulation was done by intramuscular injection of 1000 IU eCG given on the 15^{th} day of progesterone treatment All the animals in the above groups and animals in the control group were inseminated with good quality buck semen four to six hours after the onset of oestrus Embryos were collected surgically in all the eighteen goats by flushing the fallopian tube towards the

fimbria after conducting laparotomy of the inseminated goats on the left flank

All the animals in group I came to oestrus 57 8 ± 5 65 h after the second injection of $PGF_{2\alpha}$ and the duration of oestrus was 48 ± 8 76 h

In group II 83 33% were in oestrus at an interval of 101 6 + 6 11 h after the last progesterone injection and the duration of oestrus was 28 ± 1 41 h

The results of administration of eCG in the second treatment regime with $PGF_{2\alpha}$ in group I revealed that all animals in this group evinced oestrus at a mean interval of 50 3 ± 10 86 h after the second injection of $PGF_{2\alpha}$ and the mean duration of oestrus was 44 ± 4h The total number of ovulation points on both the ovaries in this group were 8 4 ± 1 94 with 4 ± 1 30 and 4 4 ± 0 748 for the right and left ovaries respectively The total number of unruptured follicles on both the ovaries was 5 33 ± 1 64

The animals in group II after administration of eCG and progesterone evinced oestrus 72 + 9 06 h after the last progesterone injection with the duration of oestrus as 38 3 ± 4 46 h The total number of ovulation points on both the ovaries was 12 8 ± 1 4 and the values were 7 5 ± 2 31 for

the right and 5 3 ± 2 04 for the left ovary The total number of unruptured follicles on both the ovaries was 3 2 ± 1 579

The results of embryo collection in animals in group I revealed that the average number of embryos collected from both the ovaries was 4 8 ± 0 97 with 2 2 ± 0 66 for the right and 2 6 ± 0 39 for the left ovary The total number of embryos collected from all the animals in both the ovaries was 24 (57 14%) of which 17 (70 83%) were transferrable

The results of embryo collection in animals in group II showed that the average number of embryos collected from both the ovaries was 6 5 ± 2 95 with 3 3 ± 1 57 for the right and 3 2 ± 1 47 for the left ovary The total number of embryos collected from all the animals in both the ovaries was 39 (50 64%) of which 29 (74 36%) were transferrable

In the control animals the total number of ovulation points on both the ovaries averaged 0 83 ± 0 166 with a value of 0 5 + 0 223 for the right and 0 33 + 0 210 for the left ovary The percentage of transferrable embryos collected was 100%

It was concluded that for the purpose of synchronisation and superovulation prostaglandin

progesterone and eCG can be effectively used in goats for embryo collection without affecting the future reproductive performance