REPRODUCTIVE PERFORMANCE OF CROSS BRED HEIFERS UNDER SPECIAL LIVESTOCK BREEDING PROGRAMME OF KERALA

N. SATHYARAJ

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

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Department of Animal Reproduction, Gynaecology and Obstetrics
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR-680651
KERALA, INDIA

DECLARATION

I hereby declare that this thesis entitled **REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS UNDER SPECIAL LIVESTOCK BREEDING PROGRAMME OF KERALA** is a bonafied 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

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N SATHYARAJ

CERTIFICATE

Certified that the thesis entitled **'REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS UNDER SPECIAL LIVESTOCK BREEDING PROGRAMME OF KERALA'** is a record of research work done independently by **Sri N Sathyaraj,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree diploma fellowship or associateship to him

Dr K N Aravinda Ghosh
(Chairman Advisory Committee)
Associate Professor and Head
Veterinary College Hospital
College of Veterinary and
Animal Sciences Mannuthy

Mannuthy

25 06 2007

CERTIFICATE

We the undersigned members of the Advisory Committee of **Sri N Sathyaraj** a candidate for the degree of Master of Veterinary Sciences in Animal Reproduction Gynaecology and Obstetrics agree that the thesis entitled **REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS UNDER SPECIAL LIVESTOCK BREEDING PROGRAMME OF KERALA** may be submitted by Sri N Sathyaraj in partial fulfillment of the requirement for the degree

Dr K N Aravinda Ghosh
(Chairman Advisory Committee)
Associate Professor and Head
Veterinary College Hospital
College of Veterinary and Animal Sciences Mannuthy

25/6/07
Dr T Sreekumaran
Associate Professor and Head
Department of Animal Reproduction
College of Veterinary and
Animal Sciences Mannuthy
(Member)

25/6/07
Dr K V Athman
Associate Director of Research
Kerala Agricultural University
Vellanikkara Thrissur
(Member)

Dr A D Mercy
Associate Professor and Head
Department of Animal Nutrition
College of Veterinary and
Animal Sciences Mannuthy
(Member)

27/10/07
External Examiner
(DR K SUBRAMANYAM NAIDU)

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Sathyaraj N

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Introduction

1 INTRODUCTION

India is predominantly an agricultural country with about 70% of its population dependent on income from agriculture and animal husbandry The livestock sector in India is fast growing and plays an important role in our rural economy Livestock resources are to be utilized opt mally to achieve the goal of nutritional security and sustainability Consumption of livestock products has been increasing over the last 20 years sustained economic growth and increase n per capita income are expected to further boost the demand of livestock products India s demand for milk and meat is estimated to be 147 and 14 million tones respectively in 2020 Changing consumption and increasing demands of livestock products would need the use of new scientific technologies to achieve goal of animal production efficiency Livestock rearing provides employment and supplementary income to the vast majority of rural households the majority of which are landless and marginal farmers

The cattle wealth of Kerala were traditionally kept for agricultural operations but they had low production traits Inspite of low availability of land and fodder the productivity of cattle in the state has been augmented through the adoption of cross breeding technology By extensive and well organized net work of AI centers Kerala is presently having over 2 million cattle and 0 6 lakh buffaloes as per 2003 livestock census The percentage of crossbred cattle is higher in the southern and central regions compared to northern districts of the State The wide spread propagat on of high yielding crossbred cattle has necessitated increased dissemination of scientific management practices among the dairy farmers thereby increasing their awareness of profitable dairy ng As dairying is becoming more and more cost benefit or ented the economic loss suffered on account of poor reproductive performance of crossbred cattle has been given more emphasis Sound reproductive management is the basis for profitable dairying

The success of cattle development depends on proper rearing of calves upto heifers from the time of birth Since they form the basic unit for future cattle wealth crossbred cattle demands utmost care from calf hood to puberty to develop them into healthy dairy herds assuring economic viability A good management and balanced feeding of the young stock will help to get optimum growth rate so that they can attain early maturity Scientific feeding and management need a lot of information about the essential nutrients that are important for different body functions

Age at puberty is an important production trait in dairy economics which is having a carry over effect throughout the economic life span of the milch animals The interval between birth and first calving is non productive stage and must be considered as an overhead cost to the milking herd In cattle the scientific management system requires heifers to be bred at 12 14 months of age so that they calve at 22 24 months of age To optimize the efficient economic returns in cow calf production system heifer should be managed to calve as early as possible so as to reduce the feed and age required to maintain them Further longer the productive life of each cow in the herd lower will be the replacement rate and smaller the size of the heifer rearing enterprise This also has an effect not only on life time performance but also on the profitability of da rying For early breeding target heifers should achieve 2/3 adult body weight of their dam This may demand supplementary feeding with better nutrients during the early period of their lifetime The above target can be achieved by better calf hood and heifer management

Normal functioning of the reproductive organs may be detrimentally affected by nutritional deficiencies during critical per ods of growth puberty gestation etc Even marginal nutrient deficiencies may be manifested as impaired fertility before other clinical symptoms are apparent Moreover malnutrition lead to lowered vitality and reduced resistance to diseases

Infertility due to nutritional causes is usually characterized by a failure of oestrum or cessation of oestrus cycle The nutritional deficiencies in heifers may result in delayed puberty and sexual maturity The animals may show delayed maturity and low fertility when the ration is deficient both qualitatively and quantitatively Major contribution of feed are metabolisable energy protein and fat Along with these parameters there can also be multiple or single deficiency of major minerals like calcium phosphorus or other trace minerals

All essential minerals are required for reproduction because of their cellular roles in metabolism maintenance and growth However these nutrients also may have specific role and function in reproductive tissue or cell type may change with the physiological state of the tissue during reproductive cycle and pregnancy The main source of minerals in the feed are the concentrate and forage

In order to improve the economic status of the poor livestock farmers of Kerala by improving the health production of milk and reproductive performance of the cattle population of State Government of Kerala had launched several schemes since independence The Special Livestock Breeding Programme (SLBP) implemented during 1976 is one among the important schemes

The special livestock breeding programme implemented by the Animal Husbandry Department since 1976 with the objective of bringing down the age at which a new born crossbred calf reaches the state of production For achieving this target the age of attaining puberty age of first conception and age at first calving have to be brought down Unless a new born crossbred calf starts milk production by the 24 month of age profit from dairy farming will be low and more farmers especially from low income group cannot be attracted to dairy farming wh ch is of prime importance in increasing milk production of the state When a cow is delivered the farmers are finding it difficult to maintain and to give adequate feed to both the cow and calf So there is every possibility of calf mortality If animals are given proper attention from birth itself and are given good quality concentrate from fourth month onwards early maturity early conception and increase in milk production can be expected Since all the prophylactic immunological measures are taken there is no possibility of death due to contagious disease So by implementing the scheme the social and economical standards of the farmers can be raised by improving the milk yield of the state

The present study is conducted to evaluate the reproductive performance of animals covered under SLBP scheme by ascertaining the rate of growth of calves and to correlate better feeding and management for the early attainment of puberty maturity and age at conception in heifers

Review of Literature

2 REVIEW OF LITERATURE

Delayed puberty and consequent delay ın the first calvıng ıs one of the major constraınts lımıtıng the reproductıve performance of daıry heıfers Perusal of lıterature revealed that only few studıes have been undertaken ın Kerala regardıng varıous factors affectıng growth rate age at puberty sexual maturıty and conceptıon rate ın heıfers

2 1 GROWTH RATE

Patel *et al* (1986) stated that most of the traıts related to reproductıon ın crossbreds were largely ınfluenced by non genetıc factors *vız* management, nutrıents and sexual health Accordıng to Patel and Dave (1987) average body weıght at first oestrus were 209±5 59 kg and 252 61+7 06 kg for Jersey x Kankrej and Holsteın x Kankrej crossbreds respectıvely The average monthly weıght gaın from 9 months prıor to puberty tıll puberty were 10 13 kg 6 50 kg and 6 12 kg ın heıfers exhıbıtıng first oestrum ın less than 750 days between 750 850 days and after 850 days respectıvely (Saxena *et al* 1991)

I ee (1997) observed that weıght gaın of young daıry replacement heıfers was hıghly varıable lowly herıtable and a poor ındıcator of eıther weıght at first calvıng or first lactatıon mılk yıeld Hıgh qualıty forage of excellent nutr ent content that encouraged hıgh rates of voluntary consumptıon was essentıal for heıfers to attaın maxımum rates of growth ın sıze and scale Jaın and Chopra (1994) observed that the average daıly weıght gaın ın phosphorus adequate and phosphorus deficıencıes dıet fed calves were 308 33±32 25 and 277 67±36 60 gm respectıvely The growth rate sıgnıficantly reduced (P<0 5) ın calves wıth deficıent dıet

Sane *et al* (1994) stated that Indian breeds may be bred at an early age after attaining a body weight of 250 kg onwards which they usually acquire between two to three years of age

According to Rajeev (1998) the average daily weight gain of heifers in different age groups as 1 ½ to less than 2 years 2 to less than 2 ½ years 2 ½ to less than 3 years and 3 years and above were 45 5+3 79g 43 54 ± 2 92g 38 96+3 68g and 15 97±3 68 respectively There was significant difference in groups except group I and II Further he observed that the average daily weight gain of heifers under moderate low and poor planes of nutrition were 46 1+2 99 g 30 42+2 62 g and 23 76±3 66 g respectively There was significant difference in weight gain for moderate plane of nutrition than that of low and poor plan of nutrition Majority of heifers were exhibiting true anoestrus and under developed genitalia under low and poor planes of nutrition

The average body weight and age at breeding were 356 kg and 483 days for Ayrshire heifers and 376 kg and 484 days for Friesian heifers respectively and the average daily gain were 660 g and 695 g respectively (Mantysaari *et al* 2002) Raut *et al* (2003) in their study on crossbred animals confirmed that the reproductive performance of crossbred animals depended on factors such as level of exotic germ plasm environment management and feeding practices

Trivedi and Patel (2004) observed that the body weight at 12 15 18 and 21 months of age in interse Jersey x Kankrej heifers had a highly significant (P<0 01) positive associations with body weight and first conception (r 0 657 to 0 838) and at first calving (r 0 701 to 0 927) indicating that individual care and standard feeding could reduce the age at first conception and calving

2 2 PUBERTY

The average age at puberty ın Jersey X Bos ndıcus crossbreds was 22 9+0 9 months (Rao and Rao 1975) Balakr shna *et al* (1985) observed the first detected heat at about 679 days ın Zebu X Holsteın crossbreds

Stelwagen and Grıeve (1990) reported that age at puberty and wıther he ght decreased lınearly wıth ıncreas ng plane of nutrıt on whereas body weıght and hıp heıght were not affected by the plane of nutrıtıon The age at puberty n crossbred heıfers ranged between 633 to 987 days (Saxena *et al* 1991) Schıllo *et al* (1992) receıved the effects of nutrıtıon and season on the onset of puberty ın beef heıfers and found that age at puberty was ınversely related to the plane of nutrıtıon Seasonal condıtıons from bırth to 12 months of age also ınfluenced tımıng of puberty onset ın heıfers

Better feedıng and effıcıent management was essentıal to avoıd the adverse effect on fertılıty ın daıry cattle (Gujar and Shukla 1990 Kharche and Gautam 1991) Bıllante *et al* (1991) reported that adequate nutrıtıon and good management to heıfers hastened the onset of puberty and onset of estrus Deresz (1992) and Andrade (1992) opıned that poor feedıng management and care were the maın reason for the delayed puberty ın daıry heıfers

Based on the qualıty and quantıty of feed fed to the heıfers ıt was notıced that better body weıght gaın and early atta nment of puberty for hıgh as well as moderate plan of nutrıtıon and poor body weıght gaın wıth delayed on set of puberty ın those heıfers fed wıth low and poor plane of nutrıtıon and poor management (Patterson *et al* 1992)

Accordıng to Bıllante *et al* (1991) and Deresze (1992) adequate good nutr tıon has sıgnıfıcant ınfluence ın heıfers for early achıevement of puberty and onset of heat Hofman and Funk (1992) observed that better planes of feedıng not only reduced the age at puberty and conception but also reduced the occurrence of calving complications Patterson *et al* (1992) opined that nutrition and management of the heifers influenced the variance in age and weight at which puberty occurred since the reproductive system was the last major organ system to mature However Keith *et al* (1992) opined that nutrition and season were the two better defined variables that influenced age at puberty but growth rate had little effect on rate of sexual maturation after a certain critical weight has been achieved Elrod and Butter (1993) reported that excess degradable prote n in the feed will reduce the fertility in heifers

Shrivastava and Kadu (1992) reported that heifers w th 26 to 30 kg birth weight reached puberty earlier than those with lower birth weight The average age at puberty was lowest in heifers with 50 percent exotic inheritance (852 32±34 08 days) followed by 75 per cent (861 2+35 31 days) and 62 5 per cent (889 71+38 95 days) exotic inheritance Das (1993) observed that the overall conception rate of animals was increased with higher level of sign ficance (P<0 01) in animals treated for deficiency based on blood parameters like Hb PCV serum protein and glucose

The average age at puberty in exotic (Bos taurus) cattle ranged between 8 to 18 months and 24 to 30 months in Indian cows of well defined breeds In non descript cows this period extended over 36 to 48 months (Sane *et al* 1994) Age at puberty in five d fferent crossbred groups of heifers fed with different percentage of urea treated wheat hay were 533 ± 27 2 507 ± 15 0 573 ± 23 0 610 ± 0 4 550 ± 25 2 days Similarly the body weight at puberty were 258 ± 5 9 253 ± 5 9 286 0 ± 13 2 286 ± 8 0 and 310 ± 17 0 kg (Saijpoul *et al* 1999) Grings *et al* (1999) reported that age at puberty was affected by sire breed and dam s age

In the field study conducted ın Kerala Rajeev (1998) found that 73 3% of heıfers exhıbıted early onset of puberty wıth moderate plane of nutrıtıon But ın anımals wıth poor and low plane of nutrıtıon only 22 7% exhıbıted puberty

The perıod between wean ng and puberty was cr tıcal ın the management of heıfers and rate of growth was ınfluenced by breed and nutrıtıon (Grıngs *et al* 1999) Mısra *et al* (2001) observed that Jersey half bred had lower age at first calvıng (1063 6±19 1 days) than the Holsteın half bred (1160 5+27 5 days) Howlett *et al* (2003) observed that age and body weıght are two crıtıcal factors that work ın concert to affect attaınment of puberty ın cattle

Chelıkanı and Ambrose (2003) stud ed the effect of dıetary energy and proteın densıty on body compos tıon attaınment of puberty and ovarıan follıcular dynamıcs ın daıry heıfers Daıry heıfers attaıned puberty at a constant body weıght and body composıtıon ındependent of dıetary manıpulatıon the sıze of the domınant follıcles ıncreased wıth age ın assocıat on wıth ıncreased LH support and heıfers realımented from a low energy dıet developed larger fist ovulatory foll cle and smaller CL wıth lower peak progesterone concentratıon n the first cycle

Bearden *et al* (2004) stated that age at puberty was affected by both genetıc and envıronmental factor whıle body weıght at puberty was affected more by genetıc factor The age and body weıght at puberty ın Punganur cattle was 827 86±48 13 days and 109 00±3 51 kg respectıvely (Bramhaıah *et al* 2003)

Anımals wıth low body weıght showed low conceptıon rate and prolonged calvıng ınterval and ımproved nutrıtıon was useful to express all the genetıc potentıals and to prevent dıseases ın heıfers (Lanyasunya *et al* 2005)

Rius *et al* (2005) reported that long day photo period in combination with elevated dietary rumen undergradable protein provided a feasible management tool to the modern dairy industry to accelerate growth and puberty in he fers

Ciccioli *et al* (2005) opined that feeding a diet with a greater amount of starch for 60 days before breeding might increase the incidence of puberty during breeding of heifers that have inadequate yearling weight Gasser *et al* (2006) opined that increasing dietary energy intake in early weaned heifers through feeding high concentrate diet from 126 to 196 days of age decreased age at puberty regardless of the diet after 196 days of age

2 3 SEXUAL MATURITY

Murdia and Tripathi (1990) reported delayed matur ty and lowered growth rate in Jersey crossbred heifer under Indian condition due to the fluctuation of climatic nutrition and managemental problems in different parts of the country Sane *et al* (1994) stated that in well fed he fers oestrus was exhibited early in life when body growth was still to reach its optimum level and further he opined that first few heats were anovulatory with irregular cycles init ally followed by sexual maturity the average age at first fert le heat in Gir heifer was 1200 00 ± 48 74 days

Sexual maturity and age at first calving could be advanced by s mple management improvements that might be cost effective in trop cal environments (Abdulla *et al* 1994) Sejrsen and Purup (1997) stated that high level of feeding resulting in high growth rates in the pre pubertal period in heifers caused severe reduction of the milk production potential Similarly Andrew (1997) reported that weight gam of young dairy heifers even over several month was highly variable lowly heritable and a poor indicator of either weight at calving or first lactation milk yield Saijpaul *et al* (1999) reported that plane of nutrition affects the age at maturıty and reproductıve performance of crossbred cow and buffaloe heıfers According to Trıvadı and Patel (2004) age at maturıty ın ınter se Jersey x Kankrej heıfers was 586 91 ± 0 28 days and body weıght was 264 00 ± 6 44 kg

Nutrıtıonal deficıency played a key role ın retarded growth and development of genıtal organs resultıng ın non functıonal ovarıes ın crossbred heıfers (Mathur *et al* 2005)

2 4 AGE AT FIRST CONCEPTION

Patel *et al* (1986) reported the age at first conceptıon as 1299 26 ± 18 36 555 76 ± 12 79 and 607 33 ± 24 27 days ın Kankrej Jersey + Kankrej and Holsteın Kankrej crossbred heıfers wh le Patel and Dave (1987) observed age at first conceptıon ın Jersey Kankrej F1 heıfers as 524 94 ± 8 19 days Age at first conceptıon ın ınter se mated Jersey x Kankrej heıfers under routıne farm management was 641 06 ± 9 60 days (Patel *et al* 1986)

According to Murdıa and Trıpathı (1990) the average age at conceptıon ın four dıfferent pure Jersey farms of Indıa vız Bhıvanı Bassı Bıdaj and Anand were 583 22 ± 9 25 597 49 ± 8 70 732 67 ± 7 56 and 525 29 ± 7 06 days respectıvely and the overall age at conceptıon beıng 549 67 ± 4 48 days Trıvedı and Patel (2004) also reported sımılar age at first conceptıon ın ınter se mated Jersey x Kankrej crossbred heıfers as 586 91 ± 10 28 days

2 5 SERVICE PER CONCEPTION

Patel *et al* (1986) reported the average number of AI per conceptıon for Kankrej Jersey x Kankrej crossbred and Holsteın Kankrej crossbred heıfers as 3 14 2 98 and 4 87 respect vely The overall number of servıces per conceptıon ın pure Jersey bred kept at four dıfferent farms of Indıa was recorded as 1 58 ± 0 04 (Murdıa and Trıpathı 1990)

Service per conception of five different groups of crossbred heifers fed with urea treated hay were 2 2 ± 1 2 1 7 ± 0 4 2 0 ± 0 7 1 0 ± 0 6 1 8 ± 0 5 (Saijpoul *et al* 1999) According to Misra *et al* (2001) number of AI per conception were 1 6 ± 0 16 1 6 ± 0 19 1 6 ± 0 19 1 7 ± 0 21 1 5 ± 0 29 1 4 ± 0 27 1 2 ± 0 26 1 9 ± 0 34 and 1 5 ± 0 32 in different groups of Jersey half bred heifers

2 6 HAEMATOLOGICAL PARAMETERS

2 6 1 Haemoglobin (g per cent)

According to Morrow (1980) the Hb level of anoestrus cow was below 9 80 g% compared to 10 60 g% in normal cycling cows Pillai (1980) observed a Hb level of 9 16 and 9 70 in anoestrus cows and heifers respectively The Hb percentage of anoestrus buffaloe was significantly lower (9 82+0 13) when compared to cycling animals (12 52±0 45) (Dhoble and Gupta 1981) Naidu and Rao (1982) observed mean Hb level of 8 39+0 92 in anoestrus and 10 25+1 45 in normally cycling cows

Sharma *et al* (1983) observed that the haemoglobin (Hb) value of anoestrus (9 05+2 05) and repeat breeder (10 0±2 5) were lower than that of normally cycling (11 95±1 90) cows

Alexander (1983) reported Hb values of 11 10±0 40 11 52±0 62 11 58±0 54 and 11 20±0 86 g% at 2 15 30 and 45 days of postpartum in normal cows and did not observe any significant difference in Hb levels between the corresponding stage of cows on higher levels of nutrition

Kumar *et al* (1985) observed the Hb levels of repeat breeding and anoestrus cows as 8 97+0 77 and 9 23±0 83 g% respectively whereas it was significantly higher in normally cycling cows as 11 48+0 98 g% However Shr vastava and Kharche (1986) and Sharma *et al* (1986) reported there was no significant difference in haemoglobin percentage between normal cycling and anoestrus heifers

Among the normal cycling fertile and infertile repeat breeder cows the average haemoglobin values were 9 06+0 29 8 98+0 29 and 8 85+0 34 per cent respectively and the difference was found non significant (Awasthi and Kharche 1987) However Kumar and Sharma (1991) observed significantly lower values of Hb n anoestrus and repeat breeding cattle Similarly Ali *et al* (1991) also observed significantly lower levels of Hb (7 92±0 25) in anoestrus rural crossbred heifers suffering from mal nutrition than in normal cycling heifers

According to Das (1993) the average Hb value of normal fertile animal was 10 06±0 618 g percent and in animals with impaired fertility it was 6 86+0 075 g percent Animals with high level of Hb had conceived 50 per cent but none of the animal with low level of Hb conceived The difference in conception rate was significant (P<0 01) between the groups However Khan *et al* (1995) reported that the value of haemoglobin do not show any significant change between the regular breed ng repeat breeding and anoestrus cows and these values were within normal physiological range According to Nayyar *et al* (1998) there was no difference in the haemoglobin values between normal and delayed pubertal buffalo heifers which were born during winter and spring season

The mean haemoglobin value of normal cycling and repeat breeders were 9 73+0 17 and 9 58+0 17 percent respectively This results indicated that there was no significant difference in value of haemoglobin percent between these two groups (Singh *et al* 2004) Koley and Biswas (2004) observed that Hb concentration of (g/dl) of anoestrus he fers was increased (P<0 01) after mineral supplementatıon from 10 58±0 10 to 11 02±0 18 g per cent but had no sıgnıficant varıatıon wıth that of normal cyclıc heıfers

In Jersey crossbred heıfers the mean value of haemoglobın ın anaestrus and oesturs condıtıon were 7 88±0 63 and 11 54±1 11 per cent respectıvely after ımprovıng feed and managemental condıtıon and dewormıng at regular ınterval The haemoglobın value at oestrus condıtıon was hıghly sıgnıficant (P<0 01) than ın anoestrus condıtıon (Das *et al* 2005)

Dhamı *et al* (2005) reported that the mean haemoglobın (per cent) value of HF cattle at dıfferent age groups were 1 2 weeks old calves 9 00+0 43 2 3 months 10 45±0 27 5 6 months 9 03±0 16 8 9 months 9 13+0 29 11 12 months old heıfers 10 03±0 42 17 18 months 11 03+0 22 22 24 months 10 10+0 32 g% The haemoglobın content was lowest ın young calves and ıncreased wıth advancıng age to reach hıghest level at puberty The low Hb content mıght be due to poor managerıal care of calves and heıfers compared to pregnant and lactat ng anımals

2 6 2 Packed Cell Volume

Rao *et al* (1981) notıced that packed cell volume (PCV) levels were lower ın recently calved anımals and ın repeaters when compared to normal cyclıng cows The PCV value of repeat breeders anoestrus and normally cyclıng cows were 27 51+3 85 27 10+4 60 and 34 51+8 85 respectıvely (Sharma *et al* 1983)

Accordıng to Gangwar *et al* (1984) PCV value were relatıvely hıgher ın buffaloes wıth better fertılıty Kumar *et al* (1985) found sıgnıficantly lower values of PCV ın anaestrus and repeat breeder cows than normal cyclıng The PCV values of repeat breedıng and anoestrus cows were 27 72±2 61 28 04+2 66 per cent respectıvely These values were lower than that of normally cyclıng cows (34 67+3 6 per cent) The normal value of PCV in cows ranged from 24 to 48 percent (Blood *et al* 1989) The PCV values were significantly lower in anoestrus and repeat breeding cattle suffering from malnutrition than in normal cycling heifers (Kumar and Sharma 1991)

According to Das (1993) the mean value of PCV in normal fertile animal was 31 00±1 33 percent wh le in impaired fertile animal was 21 50±0 50 percent It may be observed that the animal with normal PCV having high percentage of conception than the animals with low level of PCV The value of PCV has significant difference in pre partum and post partum cattle compared to repeat breeders (Rao *et al* 1981) Khan *et al* (1995) observed that the PCV value do not show any significant change in between the regular breeding cows repeat breeding and anoestrus cows The values were within normal physiological range

No difference was observed between the PCV value of normal and delayed pubertial buffalo heifers which were born during winter and spring season (Nayyar *et al* 1998) Quresh *et al* (2001) noticed that the buffaloes treated with levamisol hydrochloride showed higher PCV count than untreated group The mean value of PCV percent in Jersey crossbred heifers during anestrus and oestrus conditions ranged from 30 93+1 22 per cent to 39 70+3 00 percent respectively The increased value of PCV were due to improved feeding management and regular deworming (Das *et al* 2005)

2 6 3 Total Leukocyte Count (Per mm^3)

The mean leukocyte count was reported to be slightly higher in crossbred cows than in Gir cows (Talvalker *et al* 1980) Prasad *et al* (1984) noticed that the mean total leucocyte count on the day of induced heat was 10 09 X 10^3 cells/ mm^3 with a range of 6 10 to 14 05 x 10^3 cells / mm^3 in comparison to 10 37 x 10^3 cells/ mm^3 with the range of 5 88 to 15 75 x 10^3 cells/ mm^3 in anestrus state

However he difference was statistically non significant Sinha *et al* (1984) observed that the extent of lymphocytic infiltration in the endometrium of bovines during standing oestrus was associated with the fertility of the animal and when the score for lymphocytic infiltration increased chances of conception decreased significantly

The total leucocyte (WBC) count did not show any significant change in between the regular breeding cows repeat breeding and anoestrus cow and the values were within normal physiological range (Khan *et al* 1995) The mean WBC count of anoestrus and estrus condition of Jersey crossbred heifers were 8 44±0 81 and 5 81±0 69 percent respectively and the values were significantly (P<0 05) higher in anoestrus than estrus condition (Das *et al* 2005)

2 6 4 Total Erythrocyte Count (millions per mm^3)

According to Talvalkar *et al* (1980) the mean RBC count in crossbred animal was slightly higher compared to that in Gir cows Gangwar *et al* (1984) noticed that buffaloes with better fertility had higher values of RBC According to Khan *et al* (1995) the value of mean RBC count did not show any s gnificant change in between regular breeding cows repeat breeding and anoestrus cows The values were within normal physiological range

Das *et al* (2005) observed that the mean value of RBC count in Jersey crossbred heifers during estrus and anoestrus cond tions were 10 11+0 5 and 8 49±0 39 (10^6/mm^3) respectively The increased value of RBC were due to improvement of feeding and management and regular deworming According to Talvalkar *et al* (1980) the mean RBC count in crossbred cows was numerically higher than in Gir cows However the difference was not stat stically significant The numerical increase of RBC count could be due to nutritional environmental and management factors

2 7 BLOOD BIOCHEMICAL CONSTITUENTS

2 7 1 Calcium

Veldhis and Klase (1982) reported calcium as an integral part in steroid biosynthesis pathways of ovaries and adrenal gland and were necessary for maintenance of normal fertility Sharma *et al* (1984) observed serum calcium (mg0 percent) levels of 10 69±2 05 7 95+1 08 and 9 85+2 15 in cyclic anoestrus and repeat breeding crossbred cows respectively However Roberts (1982) reported that calcium deficiency did not cause reproductive failure in cattle

Dabas *et al* (1987) noticed a serum calcium level of 9 8±0 5 and 11 50+0 30 mg/ dl in anoestrous and cyclic cows respectively Ramakrishna (1996) reported that the mean serum calcium levels were 9 95±0 25 and 9 85+0 02/ mg per cent in the healthy and repeat breeder crossbred cows respectively Arosh *et al* (1998) observed a mean serum calcium values of 10 71±0 36 mg percent during oestrus in normal cyclic crossbred cows According to Rajeev (1998) the mean serum calcium level in normally cycling heifers were 11 1+0 3 mg percent The corresponding values for true anoestrus under developed genitalia and repeat breeders were 10 74±0 13 mg percent 10 8+0 24 mg percent and 10 8±0 42 mg percent There was no significant difference in serum calcium level among the groups Singh and Pant (1998) noticed a mean plasma calcium (mg percent) concentration of 8 42+0 22 and 8 24±0 22 in normal and repeat breeder cows

Dutta *et al* (2001) reported serum calcium levels of 10 72±0 08 9 54±0 22 and 9 95±0 18 mg per cent in cyclic postpartum anoestrus and repeat breeding animals respectively They opined that the low level of serum calcium in postpartum anoestrus and repeat breeding animals was due to failure of the endocrine system to mobilize the body calcium and the low level in cyclic animals was due to fluctuating levels of oestrogen

Das *et al* (2002) found no significant variation in serum calcium level between normal (10 5±0 44 mg%) and repeat breeding (10 045+0 327 mg%) animals Chandrahar *et al* (2003) reported that the mean serum calcium values were 6 17±0 17 and 9 63+0 36 mg% in normal and repeat breeding crossbred cows respectively

The mean calcium concentration in the peripheral blood plasma of HF cattle varied significantly from 9 92±0 59 to 12 16+0 73 mg% among different age groups with an overall mean of 11 53+0 17 mg% (Dhami *et al* 2005) The value of calcium was highest in young calves (12 16 mg%) and it declined with advancing age till maturity/ pregnancy but dropped abruptly to 9 52 mg% soon after calving and then fluctuated around 10 5 mg per cent

2 7 2 Phosphorus

Sharma *et al* (1984) observed serum phosphorus levels of 4 83±0 33 2 97+0 23 and 4 76+0 29 mg per cent in cyclic anoestrus and repeat breeding crossbred cows respectively Dabas *et al* (1987) noticed a serum inorganic phosphorus level of 6 50+0 20 and 4 30+0 31 mg/dl in cyclic and anoestrus cows respectively Infertile repeat breeders had significantly lower (3 73±0 29) inorganic phosphorus level than normal cycling (5 06+0 19) cows (Aswathi and Kharche 1987)

According to Das (1993) the average value of serum phosphorus in normal fertile animal was 4 85±0 343 mg percent and in animal with impaired fertility was 3 65±0 068 mg per cent It was observed that the animals with normal level of phosphorus having higher percentage of conception than the animals with lower level of phosphorus According to George (1995) the serum ın organıc phosphorus level ın normal fertıle group was 7 526±0 53 mg per cent whıch was sıgnıficantly hıgher than that anoestrus group (P<0 05) whıch regıstered a level of 6 082±0 33 mg per cent Even though the repeat breeder group regıstered a lower value of 6 345±0 44 mg percentage the dıfference was not statıstıcally sıgnıficant

The serum ınorganıc phosphorus level of normally cyclıng heıfers was 4 87+0 1 mg percent whıle that of anoestrus under developed gen tal a and repeat breeder were 3 83+0 09 3 52+0 1 and 4 7+0 15 respectıvely It was found that there was sıgnıficant dıfference ın serum phosphorus level of normally cyclıng group wıth anoestrus and under developed genıtalıa group (Rajeev 1998)

The serum ınorganıc phosphorus levels ın cyclıc postpartum anoestrus and repeat breedıng anımals were 4 22±0 07 3 48±0 12 and 3 36+0 13 mg percent respectıvely (Shrıvastava and Kadu 1992) Ramakrıshna (1996) reported that the plasma ınorganıc phosphorus levels were 4 51±0 18 and 5 96+0 18mg percent ın repeat breedıng and healthy crossbred respectıvely

Arosh *et al* (1998) observed an ınorganıc phosphorus level of 5 26±0 96 mg per cent durıng oestrus ın normal cyclıc crossbred cows Sıngh and Pant (1998) notıced a mean plasma phosphorus levels of 5 91+0 16 and 4 89±0 14 mg percent ın normal and repeat breeder cows Dutta *et al* (2001) reported that the ınorganıc phosphorus levels were 4 22+0 07 and 3 62+0 13 mg per cent ın normal and repeat breeder cows respectıvely Sımılarly Das *et al* (2002) reported that the serum ınorganıc phosphorus was sıgn ficantly low ın repeat breed ng cows (4 729+0 15 mg/ 100 ml) than normal cyclıc cows (5 513±0 265 mg/ 100 dl) Chandrahar *et al* (2003) also observed a sıgnıficantly low level of serum ınorganıc phosphorus ın repeat breed ng cows (3 98+0 05 mg percent) than normal healthy cows (4 60±0 04 mg per cent) Bearden *et al* (2004) op ned that deficıency of phosphorus leads to anoestrus and delayed puberty

Yadav *et al* (2004) reported a serum inorganic phosphorus level of 5 495±0 15 mg/ 100 ml n cycling cattle and 3 273+0 084 mg/ 100 ml of blood in anoestrus animals The serum inorganic phosphorus concentration in cyclic and postpartum anoestrus murrah buffaloes were 5 369+0 207 and 2 030±0 099 mg percent respectively (Rathour *et al* 2005)

2 7 3 Iron

The blood plasma iron content (µg) were 17 06±1 38 and 22 56+2 2 in repeat breeding and control group animals respectively on the day of oestrum (Parmar *et al* 1986) Das *et al* (2002) reported a serum iron level of 3 594+0 43 µg in repeat breeder cows whereas in normal cyclic cows the values were 3 424+0 053 µg Singh and Pant (1998) noticed a mean plasma iron value of 107 6±5 06 and 113 7+5 56 µg in normal and repeat breeder cows in Himachal Pradesh

There was no significant difference in the mean plasma iron levels between fertile (3 48±0 11 ppm) and infertile (3 69±0 11 ppm) group of buffaloes (Khasatiya *et al* 2005) Kavani *et al* (2005) studied the biochemical profile during fertile and infertile oestrus cycle on day 0 7 14 and 21 in surti buffaloes and reported that the mean plasma values of iron increased in fertile and was probably associated with establishment of pregnancy

2 7 4 Copper

Desai *et al* (1982) stated that copper had a significant role in maintaining the optimum fertility in Surt buffaloes Parmar *et al* (1986) reported that the blood plasma copper (µg) level of repeat breeder cows varied from 0 91+0 15 at early follicular phase to 1 04+0 16 at early luteal phase of oestrus cycle whereas ın control anımals ıt was from 1 82+0 29 at early follıcular phase to 1 95+0 22 at early luteal phase of reproductıve cycle The varıatıon mıght be due to altered metabolısm of copper ın repeat breedıng anımals

Dabas *et al* (1987) notıced a serum copper level of 185+11 and 130+8 µg ın cyclıc and anoestrus cows respectıvely The plasma copper levels were 126 54+6 03 93 24+5 77 and 82 16+3 83 mg/dl ın heıfers exhıb tıng first oestrus ın less than 750 days between 750 850 days and after 850 days respect vely (Saxena *et al* 1991)

Vandhere and Sıngh (1989) observed a mean blood plasma copper value of 138 47+11 2 mg/dl ın post partum anoestrus crossbred cows The serum copper levels were 104 17±3 76 and 73 33±3 35 mg% ın normal cyclıng and anoestrus cows respectıvely (Vhora *et al* 1995) Accordıng to George (1995) the copper concentratıon ın the serum of anoestrus anımal was 0 509±0 591 ppm and that ın repeat breeder group was 0 542+0 0415 ppm Both these were sıgnıficantly lower (P<0 01) than the serum copper level of normal fertıle group whıch regıstered a value of 0 733±0 0511 ppm

The mean serum copper level ın cyclıng heıfers was wıthın the normal range (1 26+0 07 ppm) and that of anoestrus and under developed gen talıa were found sub normal ı e 0 9 ±0 04 ppm and 0 71+0 05 ppm respectıvely and there was sıgnıficant dıfference among the three groups (Rajeev 1998)

Accordıng to Das *et al* (2002) the serum copper concentratıon ın normal cyclıc cows was sıgnıficantly hıgher (0 97±0 023 mg/ml) as compared to repeat breeders (0 69+0 017 mg/ ml) Dutta *et al* (2002) reported that the mean serum copper levels were 1 11+0 09 and 1 13+0 02 ppm ın normal and repeat breeder crossbred cows respectıvely

Singh *et al* (2004) reported that the mean plasma copper level did not have any influence on early or late occurrence of postpartum estrum in buffaloes Oestrum was observed in 90 3 percent (28/30) of the animals following subcutaneous administration of 150 mg of copper glycinate in anoestrus buffaloes and conception occurred in 63 6 percent of buffaloes (Randhawa *et al* 2004) The plasma copper (ppm) level was higher in infertile surti buffaloes than fertile animals in day 0 7 14 and 21 day post breeding (Kavani *et al* 2005) Khasatiya *et al* (2005) studied the reproductive performance and mineral profile of postpartum fertile and infertile surti buffaloes and found a significant correlation of copper with service period and calving internal

2 7 5 Cobalt

According to George (1995) eventhough the concentration of cobalt obtained for different groups were not significantly different highest was registered for repeat breeders 0 079+0 0111 ppm followed by normal cycling group 0 0702+0 0100 ppm and the lowest in anoestrus group 0 0641+0 0052 ppm However Vhora *et al* (1995) observed significant higher level of serum cobalt in normal cycling cows than in anoestrus cows

Bearden *et al* (2004) stated that copper and cobalt deficiencies were associated with depressed oestrus low fertility and abnormal fetal development Singh *et al* (2004) reported a mean plasma cobalt level (mg/ ml) of 0 541±0 024 in buffaloes exhibiting oestrum within 90 days of calving and the corresponding values in animal exhibiting oestrum after 90 days postpartum was 0 477+0 020

According to Khasatiya *et al* (2005) the mean concentration of cobalt was significantly higher in fertile (0 61+0 2 ppm) than infertile (0 52+0 01 ppm) buffaloes

2 7 6 Zinc

Dabas *et al* (1987) noticed a serum zinc level of 310+13 and 305+9 mg/dl in cyclic and anoestrus cows respectively Prasad *et al* (1989) found that the average serum zinc values were 80 150 mg/100 ml in the normal crossbred cows The plasma zinc levels were 233 06±16 70 182 44+12 28 and 160 68+11 39 mg/dl in heifers exhibiting first oestrum in less than 750 days between 750 850 days and after 850 days respectively (Saxena *et al* 1991) According to George (1995) the zinc level in serum of anoestrus group was 1 028±0 984 ppm and that of repeat values were lower than that of normal breeding group which registered a value of 1 337±0 155 ppm but the difference was statistically insignificant

The mean serum zinc were 1 71±0 05 ppm 1 61+0 03 ppm 1 6+0 05 ppm and 1 73+0 06 ppm for cycling heifers and heifers with true anoestrus under developed genitalia and repeat breeders respectively (Rajeev 1998) Dutta *et al* (2002) reported that the mean serum zinc values were 1 80+0 16 and 0 97±0 01 ppm in normal and repeat breeder cows respectively

Das *et al* (2002) reported that the mean concentration of zinc in repeat breeder was significantly lower (1 08±0 003 mg/ml) than that of normal cyclic cows (2 09+0 057 mg/ml) Shah *et al* (2003) observed no significant variation in the mean plasma zinc levels during the postpartum period in fertile and infertile surti buffaloes Similarly Singh *et al* (2004) also observed no significant difference in the plasma zinc level between buffaloes showing oestrum within or after 90 days postpartum

According to Reece (2004) the zinc deficiency alters the synthesis the prostaglandins which may affect the reproductive function in domestic animals

Kavani *et al* (2005) reported higher zinc level in fertile cycle (1 96+0 24 ppm) than in infertile cycle (1 44+0 13 ppm) in buffaloes On contrary

Khasatıya *et al* (2005) reported a hıgher zınc level ın ınfertıle anımals than fertıle anımals from eıght week postpartum

2 7 7 Manganese

Parmer *et al* (1986) notıced a blood plasma manganese level (mg/ml) of 0 19±0 03 and 0 58+0 08 durıng oestrus phase ın repeat breedıng and control anımals respectıvely

Accordıng to George (1995) the serum manganese level of 0 0339±0 0052 ppm regıstered for the anoestrus group was lower than that of repeat breeders whıch regıstered a value of 0 0422+0 0033 ppm but for normal fertıle group a hıgher value of whıch was 0 0553±0 0095 ppm was recorded However the dıfference was not statıstıcally sıgnıficant

Reproductıve dısorders lıke anoestrus poor follıcular development, delayed ovulatıon sılent oestrus and reduced conceptıon rate were produced due to manganese deficıency (Noakes *et al* 2001) Accordıng to Das *et al* (2002) the concentratıon of manganese ın normal cyclıc crossbred cows was lower (0 49±0 028 mg/ml) than repeat breeder cows (0 529±0 40 mg/ ml)

Dutta *et al* (2002) reported that the mean serum manganese levels were 0 58+0 03 and 0 23+0 02 ppm ın normal cyclıc and repeat breeder crossbred cows respectıvely however the mean plasma manganese level dıd not exhıbıt any sıgnıficant varıatıon durıng the postpartum perıod Shah *et al* (2003) reported that the manganese level ın ınfertıle cycle was hıgher (0 14±0 01 ppm) compared to the fertıle cycle (0 09+0 01 ppm) Khasatıya *et al* (2005) reported that the concentratıon of manganese ın fertıle buffaloes (0 08±0 01 ppm) were lower than that of ınfertıle buffaloes (0 11+0 01 ppm)

Materials and Methods

3 MATERIALS AND METHODS

The present investigation was carried out to study the influence of better feeding and management of calves selected under Special Livestock Breeding Programme (SLBP) implemented by the Department of Animal Husbandry of Kerala Twenty two calves which were covered under SLBP and 11 calves which were not covered under SLBP were selected at random to form group I and II respectively All the animals in both groups belonged to farmers below poverty line (BPL) of Anthikad Villadam and Ollukkara Villages of Trichur district

Group I animals were fed with good quality compounded cattle feed supplied to farmers at 50% subsidized rate from Department of Animal Husbandry and provided extension support adequate health and insurance cover

The prescribed ration fed to the different age group of animals were as follows

1 Sixth month of age 1 75 kg per day
2 Seven to Eighteen month of age 2 kg per day
3 Nineteen to 24 month of age 2 5 kg per day

These animals were closely monitored at monthly intervals and were dewormed at regular intervals

Group II (control) animals were maintained by poor farmers under field condition and their feeding and management were fully dependent on the interest and capability of the farmers

3 1 BODY WEIGHT

The body weight of all animals in group I and II were recorded at 6^{th} 12^{th} and 18^{th} month of age and at puberty and sexual maturity The body weight in kg was calculated using Shaffers formula $LG^2/ 660$ where L is the length of the body in inches from crown to ramp and G the girth in inches The daily weight gain of individual heifers were calculated from the difference in body weight obtained at six month interval till 18^{h} month of age

3 2 HAEMATOLOGICAL PARAMETERS

Five ml of blood was collected from the jugular vein of all the animals in test tubes containing 5 mg of EDTA at 6^{th} 12^{th} and 18^{th} months of age and at puberty and sexual maturity Blood samples were subjected to the estimation of haemoglobin packed cell volume total erythrocyte and total leukocyte counts and values obtained were subjected to statistical analysis

3 3 BLOOD BIOCHEMICAL CONSTITUENTS

Ten ml of blood was collected from jugular vein of all the animals in test tubes at 6^{h} 12^{th} and 18^{th} month of age and at puberty and sexual maturity and was allowed to clot The serum was separated and collected in separate serum vials The level of calcium copper iron cobalt zinc and manganese were estimated by Perkin Elmer atomic absorption spectrophotometry and phosphorus by colorimetry (UV visible Spectrophotometer)

3 4 AGE AT PUBERTY

The age at which the female animals showed the evidence of onset of cyclical activity for the first t me was taken as the age of puberty The attainment at age of puberty of all the animals in both experimental and control groups were recorded

3 5 AGE AT MATURITY

The age at which the female animals showed the regular oestrus cycles w th ovulation for the first time was taken as the age at sexual maturity

3 6 CONCEPTION RATES

Detailed clinco gynaecological examinat on was carried out in heifers exhibiting oestrus symptoms to assess the reproductive health Those animals attained sexual maturity were subjected to artificial insemination during standing oestrum and the conception rates were assessed by per rectal examination in both experimental and control group upto 24 months of age

3 7 STATISTICAL ANALYSIS

The data obtained were compiled and subjected to statistical analysis as per Snedecor and Cochran (1994)

Results

4 RESULT

Results of the investigations on **Reproductive Performance of Crossbred Heifers under Special Livestock Breeding Programme of Kerala** are presented below

4 1 BODY WEIGHT AND DAILY WEIGHT GAIN

The body weight of group I and II animals at 6th 12th and 18th month of age and at puberty and maturity are shown in Table 1 and Fig 1 The mean value of body weight (kg) in animals belonging to group I at 6th 12th and at 18th month of age were 68 32+0 88 116 59+0 94 and 178 36+1 36 and in group II were 69 36+1 00 83 26±0 84 and 102 16+0 29 respectively Similarly body weight in group I at puberty and maturity were 165 5+0 08 and 174 55+1 7 and in Group II were 155 26+0 29 and 165 24±0 20 respectively Statistical analysis revealed that group I had significance (P<0 01) compared to group II animals

The daily weight gain of animals belonging to group I and II from 6th to 12 h month of age were 268 22 g per day and 77 2 g per day respectively and that from 12th to 18th month of age were 343 16 and 105 g per day respectively (Table 2)

4 2 ATTAINMENT OF PUBERTY

The percentage of animals attaining puberty at different age groups are shown in Table 3 and Fig 2 Six animals in group I (27 30 per cent) but none in group II had reached puberty below 12th month of age Between 13th to 15th month of age 8 animals in group I (36 36 percent) but none in group II reached puberty Between 16 to 18 months of age 6 animals in group I (27 30 percent) and none in group II reached puberty The percentage of animals attained puberty during 19th to 21th month in group I and II were 2 (9 10 per cent) and 1 (9 10 per cent) respectively In group II between 22 to 24 month of age only one animal reached puberty It is found that all the experimental animals exhibited puberty before 21 month of age while only 2 (18 2 per cent) exhibited estrus in group II by 24th month of age

The mean overall age at puberty in group I experimental animals were 448 68+16 20 days where as in group II animals were 645 days by 24 months of age (Table 3) There is highly significant difference (P<0 01) in overall age at puberty between these two groups

4 3 ATTAINMENT OF MATURITY

The percentage of animals attaining maturity at different age groups are shown in Table 4 and Fig 3 Three animals in group I (13 63%) but none in group II had reached maturity below 12th month of age Between 13 15 months of age 10 animals in group I (45 45%) and no animals in group II reached maturity Between 16th to 18th month of age 5 animals in group I (22 72%) but none in group II reached maturity Between 19th to 21^{s} month of age 2 animals in group I (9 10%) and no animals in group II reached maturity Between 22nd to 24th month of age 2 animals in group I (9 10 per cent) and 2 animals in group II (18 20%) had reached maturity It is seen that all the experimental animals in group I reached maturity by 24 months of age while only 2 (18 20%) reached maturity in control group

The mean overall age at maturity in group I experimental animals were 515 09+15 06 days whereas in group II animals were 686 days The difference in age at maturity between the two groups was significant (P<0 01)

4 4 AGE AT CONCEPTION

Number of animals conceived between 13 15 month 16 18 month and 19 21 month of age in group I were 1 (4 5%) 2(9 1%) and 4 (18 2%) respectively but none group II conceived prior to 21 months of age (Table 5 and Fig 4)

Between 22 24 month of age 7 (31 8%) ın group I and 2 (18 2%) ın group II conceıved It ıs seen that a total of 14 (63 6%) ın group I whereas only 2 (18 2%) ın group II conceıved by 24 months of age

The overall age at conceptıon ın group I experımental anımal were 619 79+22 66 days where as ın group II control anımals 716 days There was sıgnıficant (P<0 01) dıfference ın overall age at conceptıon between these two groups

4 5 CONCEPTION RATE

The number of AI per conceptıon ın group I anımals was 1 86 whereas n group II was 2 5 There was sıgnıficant dıfference (P<0 01) ın number of AI per conceptıon between these two groups

The heıfers covered under SLBP attaıned maturıty at an early age and obtaıned a hıgher conceptıon rate when compared to that of control group

4 6 HAEMATOLOGICAL PARAMETERS

Haematologıcal parameters such as haemoglobın packed cell volume total leukocyte count and total erythrocyte count were estımated ın all the anımals at 6th 12th and 18th month of age and at puberty and maturıty (Table 6)

4 6 1 Haemoglobın (g per cent)

The mean value of haemoglobın ın anımals belongıng to group I experımental anımals at 6th 12th and 18th month of age were 6 24+0 25 9 8+0 27 and 10 47±0 19 and ın group II anımals were 6 36+0 31 7 85±0 18 and 7 86+0 18 respectıvely Sımılarly the Hb percentage of group I anımals at puberty and maturıty were 9 83±0 25 and 9 78+0 24 and group II were 8 01+0 17 and group II were 8 22±0 137 respectıvely (Table 6 and Fıg 5) The statıstıcal analysıs revealed that the anımals ın group I had sıgnıficance (P<0 01) ın Hb level from 12th month of age to maturity when compared to the animals of group II

4 6 2 Packed Cell Volume (Percentage)

The mean value of packed cell volume in animals belonging to group I at 6th 12th and 18th month of age were 24 50±0 61 28 27±0 63 and 30 89+0 18 and in group II were 24 32+0 67 24 64+0 33 and 25 91±0 51 respectively Similarly the PCV value of group I animals at puberty and maturity were 29 18±0 49 and 30 09+0 43 and in group II were 26 45+0 31 and 26 73±0 30 respectively (Table 6 and Fig 6) The statist cal analysis showed that group I animals had higher level of significance (P<0 01) from 12th month of age to matur ty when compared to animals of group II

4 6 3 Total Leukocyte Count (Per mm^3)

The mean value of Total Leukocyte Count (TLC) in animals belonging to group I at 6 h 12th and 18 h month of age were 6204 55+373 79 5704 55+407 77 and 5700±0 512 and in group II were 6090 91±0 27 6090 91±365 42 and 6218 18±291 respectively (Table 6 and Fig 7) Similarly TLC of group I animals at puberty and maturity were 5686 36+33 09 and 5663 64+26 76 and group II were 6218 18±254 35 and 6272 73+243 8 respectively The statistical analysis revealed that group II animals had significance (P<0 01) from 12 h month to maturity when compared to the animals of group I

4 6 4 Total Erythrocyte Count (Millions per mm^3)

The mean value of total erythrocyte count in animals belonging to group I at 6th 12th and 18th month of age were 3 90+0 27 6 44+0 23 and 7 38±0 29 and in group II animals were 3 33+0 140 4 02±0 189 and 4 45+0 170 respectively Similarly the total erythrocyte count of group I animals at puberty and maturity were 6 46+0 23 and 6 42+0 04 and in group II were 4 95+0 23 and 5 05+0 07 respectively (Table 6 and Fig 8) The statistical analysis showed that group I animals had significance (P<0 01) from 12th month of age to maturity when compared to animals of group II

4 7 BLOOD BIOCHEMICAL CONSTITUENTS

The results obtained on study of blood biochemical constituents such as calcium phosphorus iron cobalt copper zinc and manganese at 6th 12 h and 18th month of age and at puberty and maturity were presented in Table 7 and Fig 9 to 15

4 7 1 Calcium (mg per cent)

The mean value of calcium obtained in animals belonging to group I at 6th 12 h and 18 h month of age were 9 49+0 170 9 73+0 150 and 10 64+0 140 and group II were 9 63±0 600 9 65±0 180 and 8 53+0 100 respectively Similarly the mean value of calcium in group I animals at puberty and maturity were 10 01+0 125 and 10 04±0 124 and in group II were 10 04±0 09 and 10 01+0 070 respectively (Table 7 and Fig 9) The statist cal analysis revealed that there was no significant difference in the values of calcium between the two groups

4 7 2 Phosphorus (mg percent)

The mean value of phosphorus in animals belonging to group I at the age of 6th 12th and 18th month were 4 5+0 139 5 07+0 103 and 5 31±0 109 and group II were 4 12±0 127 3 88±1 103 and 4 02+0 09 respectively Similarly the phosphorus level in group I animals at puberty and maturity were 5 18+0 070 and 5 30±0 090 and group II were 4 07±0 050 and 3 98+0 050 respectively (Table 7 and Fig 10) The statistical analysis revealed that the group I animals had higher level of significance (P<0 01) when compared to group II animals from 12th month of age to maturity

4 7 3 Iron (ppm)

The mean value of iron in animals belonging to group I at the age of 6th 12th and 18th month were 1 06+0 007 1 51+0 122 and 1 00±0 002 and group II were 1 04±0 062 0 99±0 080 and 0 97+0 050 respectively (Table 7 and Fig 11) Similarly the values in group I animals at puberty and maturity were 1 44+0 11 and 1 49±0 120 and in group II were 1 01+0 040 and 1 04±0 040 respectively The statistical analysis showed that group I animals had significance (P<0 01) when compared to group II animals from 12th month of age to maturity

4 7 4 Cobalt (ppm)

The mean value of cobalt in animals belonging to group I at the age of 6th 12th and 18th month were 0 26±0 006 0 22+0 002 and 0 23±0 002 and group II were 0 16+0 020 0 16+0 020 and 0 17+0 020 respectively (Table 7 and Fig 12) Similarly the values in group I and group II at puberty and maturity were 0 32+0 005 and 0 33±0 006 and 0 26+0 200 and 0 25+0 010 respectively The statistical analysis showed that group I animals had significance (P<0 01) at 18th month of age and at maturity when compared to group II

4 7 5 Copper (ppm)

The mean value of copper in animals belonging to group I at 6th 12 h and 18th month of age were 0 53±0 003 0 55+0 003 and 0 55±0 004 and group II were 0 39±0 070 0 38+0 030 and 0 38+0 020 respectively Similarly the values in animals belonging to group I at puberty and maturity were 0 54±0 046 and 0 51±0 040 and group II were 0 42±0 020 and 0 41+0 010 respectively (Table 7 and Fig 13) The statistical analysis had revealed that group I animals had significance (P<0 01) when compared to group II

4 7 6 **Zinc (ppm)**

The mean value of Zinc in animals belonging to group I at 6th 12th and 18th month of age were 0 68+0 003 0 62+0 005 and 0 66+0 004 and in group II were 0 66+0 240 0 61+0 050 and 0 66+0 040 respectively (Table 7 and Fig 14) Similarly the values in animals belonging to group I at puberty and maturity were 0 73+0 070 and 0 77+0 057 and group II were 0 71±0 030 and 0 76+0 030 respectively There is no significant difference in the zinc level between the group I and II at any stage of growth

4 7 7 **Manganese (ppm)**

The mean value of manganese in animals belonging to group I at 6th 12th and 18th month of age were 0 04+0 001 0 03+0 001 and 0 03±0 003 and in group II were 0 04+0 003 0 03±0 010 and 0 03+0 020 respectively S milarly the values in animals belonging to group I at puberty and maturity were 0 081±0 030 and 0 09+0 020 and in group II were 0 08±0 040 and 0 09±0 030 respectively (Table 7 and Fig 15) There is no significant difference in the manganese level between the two groups at any stage of growth

Table 1 Body weight of Group I and II animals at 6th, 12th and 18th month of age and at puberty and maturity

Group No	Parameters	6 h month of age	12 h month of age	18 h month of age	At puberty	At maturity
I	Body weight (Kg)	68 32+0 88	116 59±0 94	178 36±1 36	165 5±0 08	174 55+1 70
II	Body weight (Kg)	69 36±1 00	83 26±0 84	102 16±0 29	155 26±0 29	165 24+0 20

Table 2 Average daily weight gain of group I and II animals

Sl No	Groups	6 to 12 months of age weight gain in g/day	12 to 18 months of age weight gain in g/day
1	Group I (Experimental animals)	268 22	343 16
2	Group II (Control Animals)	77 20	105 00

Table 3 Age at puberty in Group I and II animals

		Number and percentage of animals attained puberty						
Groups	**Total number of animals**	**Below 12 month of age**	**13 to 15 month of age**	**16 to 18 month of age**	**19 to 21 month of age**	**22 to 24 months of age**	**Total animals**	**Overall age at puberty (days)**
Group I (Experimental animals)	22	6 (27 3%)	8 (36 36%)	6 (27 3%)	2 (9 1%)		22 (100%)	448 68+16 2
Group II (Control Animals)	11				1 (9 1%)	1 (9 1%)	2 (18 2%)	645

Table 4 Age at maturıty ın Group I and II anımals

Groups	Total number of anımals	Below 12 month of age	13 to 15 month of age	16 to 18 month of age	19 to 21 month of age	22 to 24 months of age	Total Anımals	Overall age at maturıty (days)
Group I (Experımental anımals)	22	3 (13 63%)	10 (45 45%)	5 (22 72%)	2 (9 1%)	2 (9 1%)	22 (100%)	515 09±15 06
Group II (Control anımals)	11					2 (18 2%)	2 (18 2%)	686

Table 5 Age at conception and conception rate in Group I and II

Groups	Total number of animals	Below 12 month of age	13 to 15 month of age	16 to 18 month of age	19 to 21 month of age	22 to 24 months of age	Total	Overall age at conception	Number of AI per conception
Group I (Experimental animals)	22		1 (4 5%)	2 (9 1%)	4 (18 2%)	7 (31 8%)	14 (63 6%)	619 79±22 66	1 86
Group II (Control animals)	11					2 (18 2%)	2 (18 2%)	716	2 50

Table 6 Haematologıcal parameters of Group I and II anımals at 6^{th}, 12^{th} and 18^{th} month of age and at puberty and maturıty

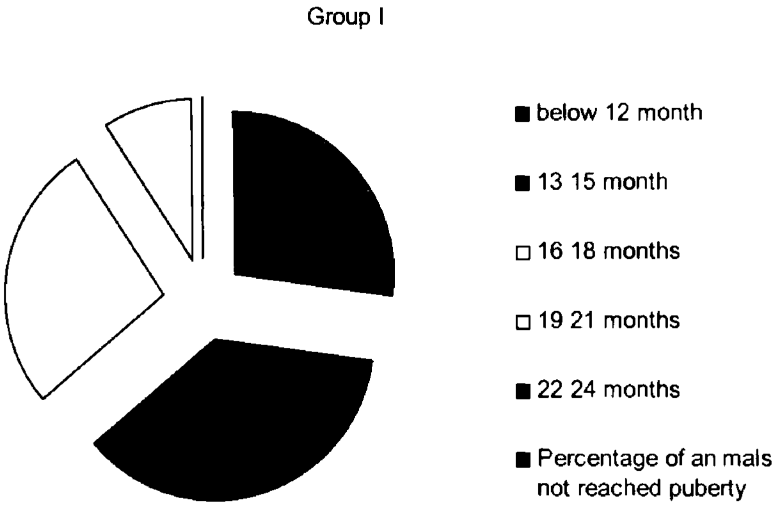
Sl No	Parameters	6 h month of age		12 h month of age		18 h month of age		At Puberty		At Maturıty	
		Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
1	Hb (g%)	6 24+ 0 25	6 36+ 0 31	9 8± 0 27	7 85+ 0 18	10 47+ 0 19	7 86± 0 18	9 83+ 0 25	8 01± 0 17	9 78+ 0 24	8 22+ 0 14
2	PCV (%)	24 50± 0 61	24 32+ 0 67	28 27± 0 63	24 64± 0 33	30 89± 0 18	25 91+ 0 51	29 18+ 0 49	26 45+ 0 31	30 09+ 0 43	26 73± 0 30
3	TLC (per mm^3)	6204 55+ 373 79	6090 91+ 0 27	5704 55+ 407 77	6090 91+ 365 42	5700+ 0 512	6218 18± 291	5686 36± 33 09	6218 18+ 254 35	5663 64+ 26 76	6272 73+ 243 80
4	RBC (10^6/cmm)	3 90+ 0 27	3 33± 0 14	6 44± 0 23	4 02± 0 18	7 38+ 0 29	4 45± 0 17	6 46+ 0 23	4 95+ 0 23	6 42+ 0 04	5 05+ 0 07

Table 7 Blood biochemical profile of Group I and II animals at 6th, 12th and 18th month of age and at puberty and maturity

Sl No	Parameters	6^{h} month of age		12th month of age		18^{h} month of age		At Puberty		At Maturity	
		Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
1	Ca (mg %)	9 49+ 0 170	9 63± 0 600	9 73+ 0 150	9 65+ 0 180	10 64+ 0 140	8 53+ 0 100	10 01+ 0 125	10 04+ 0 090	10 04+ 0 124	10 01+ 0 070
2	P (mg %)	4 5± 0 139	4 12± 0 127	5 07+ 0 103	3 88+ 1 103	5 31+ 0 109	4 02+ 0 090	5 18+ 0 07	4 07+ 0 050	5 30+ 0 090	3 98± 0 050
3	Fe (ppm)	1 06± 0 007	1 04± 0 062	1 51+ 0 122	0 99+ 0 080	1 00+ 0 002	0 97+ 0 050	1 44+ 0 110	1 01+ 0 040	1 49± 0 120	1 04± 0 040
4	Co (ppm)	0 26+ 0 006	0 16± 0 020	0 22± 0 002	0 16+ 0 020	0 23± 0 002	0 17± 0 020	0 32+ 0 005	0 26+ 0 200	0 33+ 0 006	0 25± 0 010
5	Cu (ppm)	0 53± 0 003	0 39+ 0 070	0 55+ 0 003	0 38± 0 030	0 55+ 0 004	0 38+ 0 020	0 54+ 0 046	0 42+ 0 020	0 51+ 0 040	0 41+ 0 010
6	Zn (ppm)	0 68+ 0 003	0 66± 0 240	0 62+ 0 005	0 61+ 0 050	0 66+ 0 004	0 66+ 0 040	0 73+ 0 070	0 71+ 0 030	0 77± 0 057	0 76+ 0 030
7	Mn (ppm)	0 04± 0 001	0 04+ 0 003	0 03+ 0 001	0 03± 0 010	0 03± 0 003	0 03± 0 020	0 081+ 0 030	0 08+ 0 040	0 09+ 0 020	0 09+ 0 030

Fig 1 Mean body weight of animals at different age groups in Group I and II

Fig 2 Age at puberty n gr up I & II anımals



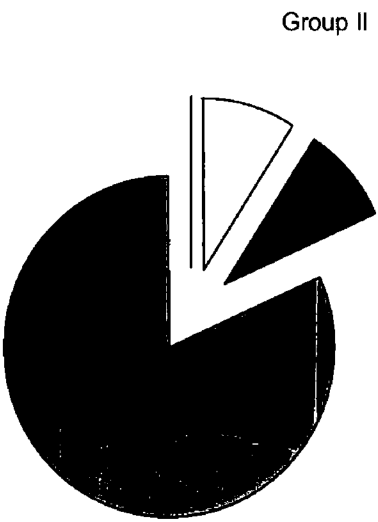


Fig 3 Age at maturity in group I & II animals

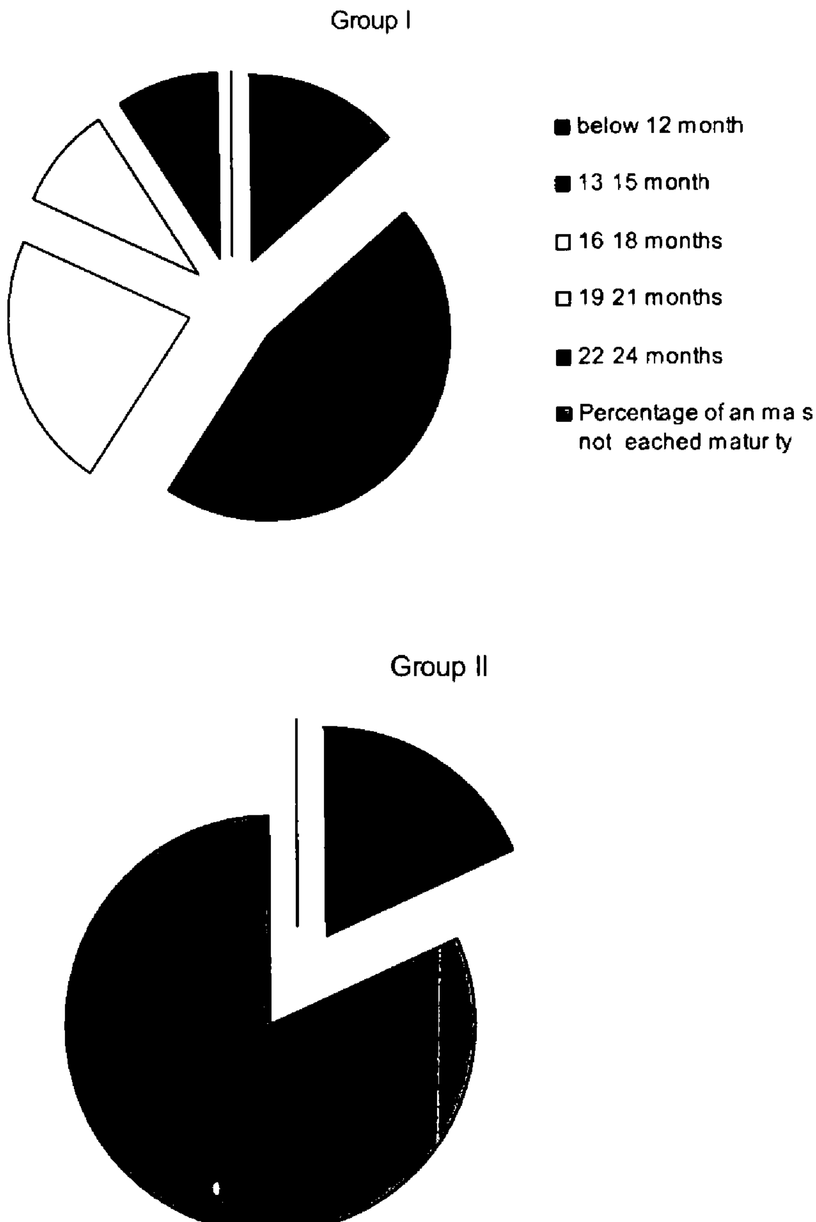
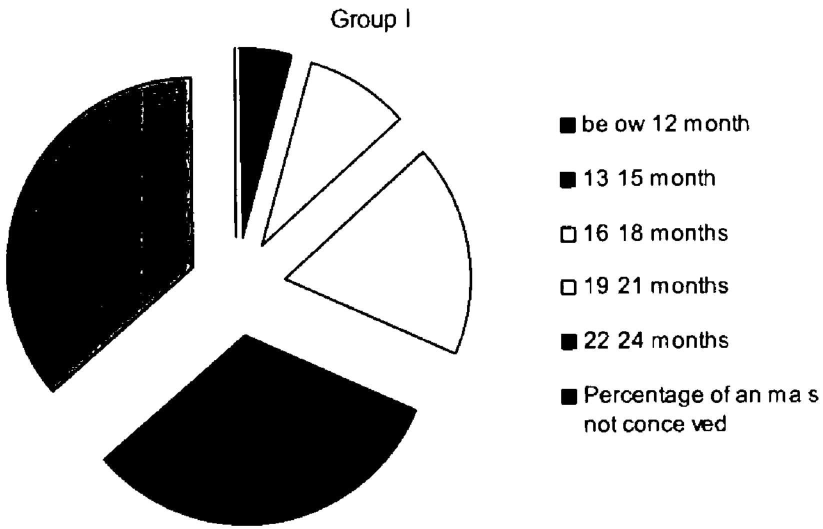


Fig -4 Age at conception in group I & II animals



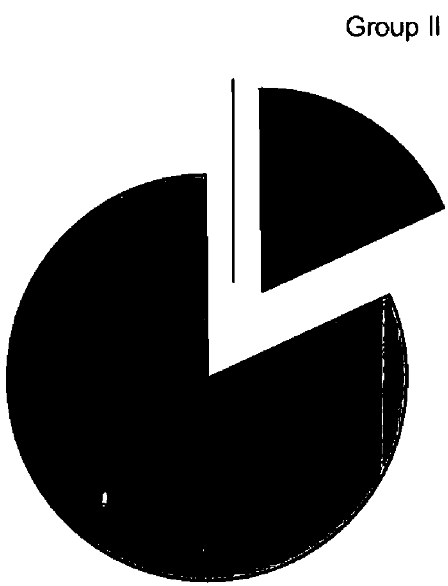


Fig 5 Mean Values of Hemoglobin of animals at different age groups in Group I and II

Fig 6 Mean values of PCV of animals at different age groups in Group I and II

Fig 7 Mean WBC counts of animals at different age groups in Group I and II

Fıg 8 Mean RBC count of an mals at dıfferent age groups ın Group I and II

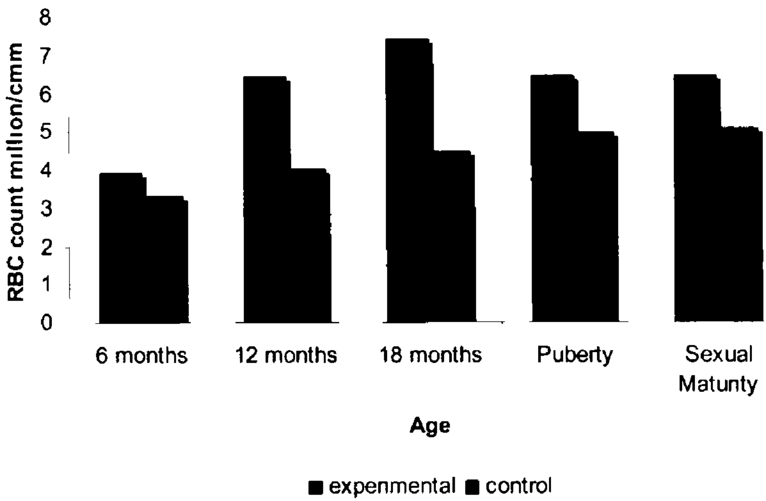


Fıg 9 Mean values of serum calcıum of anımals at dıfferent age groups n Group I and II

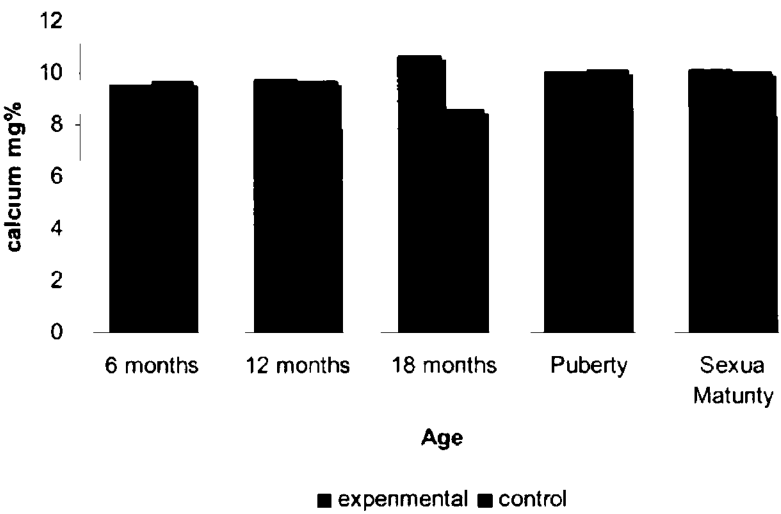


Fig 10 Mean values of serum phosphorus of animals at different age groups in Gr up I and II

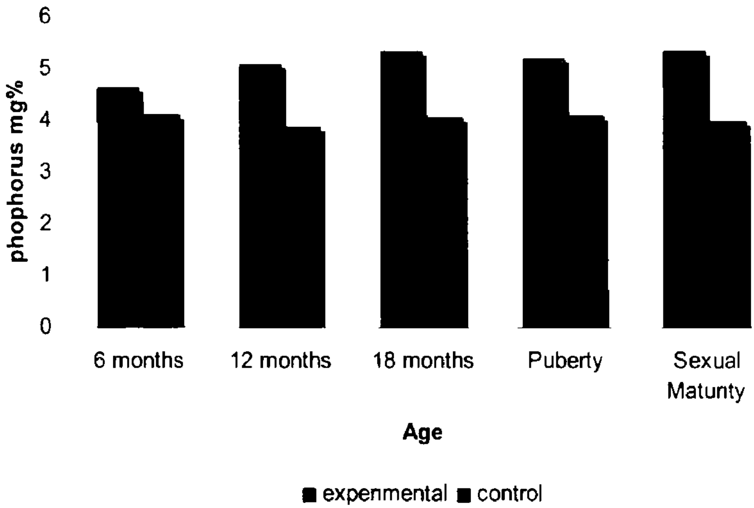


Fig 11 Mean values of serum iron of animals at different age groups in Group I and II

Fig 12 Mean values of serum cobalt of animals at different age groups in Group I and II

Fig 13 Mean values of serum copper of animals at different age groups in Group I and II

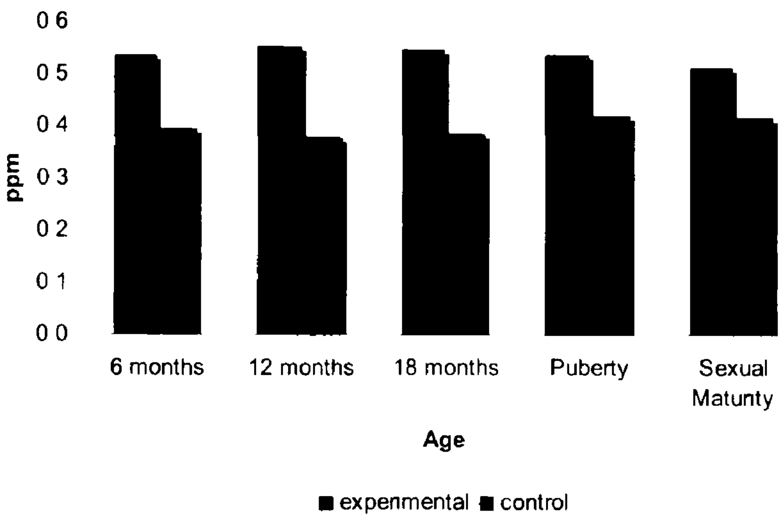
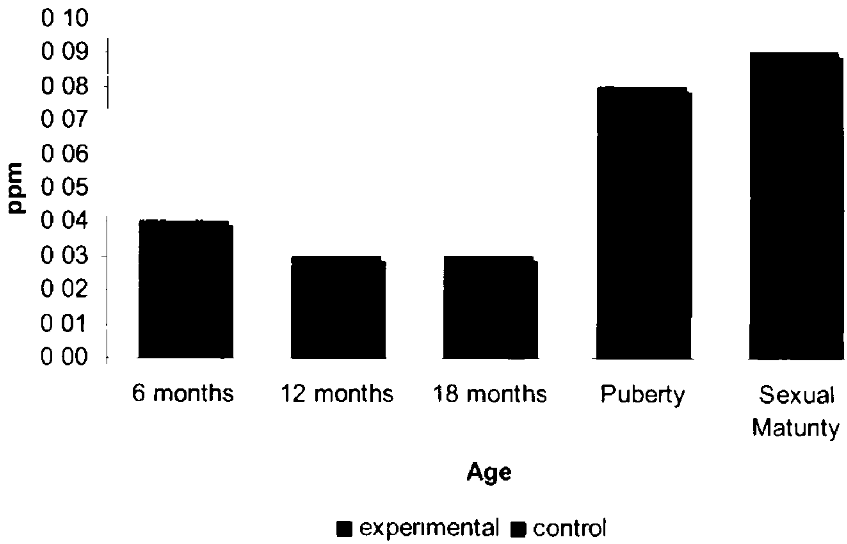


Fig 14 Mean values of serum z nc f animals at d fferent age groups in Group I and II

Fig 15 Mean values of serum manganese of an mals at different age groups n Group I and II



Discussion

5 DISCUSSION

The present study was undertaken to ascertain the rate of growth of calves enrolled under special Livestock Breeding Programme of Kerala from 6th month of age to age at puberty maturity and conception upto 24 months of age The study was conducted in animals reared under field conditions and was aimed to correlate better feedings and management for improving the reproductive performance of these animals

5 1 BODY WEIGHT AND DAILY WEIGHT GAIN

The body weight of animals covered under SLBP (Group I) at 6th 12th and 18th months were 68 32 ± 0 88 116 59 ± 0 94 and 178 36 ± 1 36 and in group II were 69 36 ± 1 0 83 26 ± 0 84 and 102 16 ± 0 29 kg respectively Similarly body weight in group I at puberty and maturity were 165 5 ± 0 08 and 174 55 ± 1 7 and in group II were 155 26 ± 0 29 and 165 24 ± 0 2 kg respectively (Table 1 and Fig 1) Statistical analys s revealed that group I animals had highly significance value at 12th to 18th month of age and at puberty and maturity as compared to group II controlled animals This shows that improved feeding and better management positively influenced the growth rate of animals covered under SLBP and resulted in early atta nment of puberty and maturity These findings agree with the findings of Patel *et al* (1986) and Lee (1997) who correlated the reproductive performance of crossbred heifers largely influenced by nongenetic factors like nutrition ma iagement and sexual health

It was seen that the daily weight of animals belonging to group I from 6th to 12th month of age was 268 22 g per day and from 12th to 18th month of age was 343 16 g per day which was significantly higher as compared to values of 77 2 g and 105 g per day respectively in control animals (Table 2) However Rajeev (1998) reported lower weight gain at var ous stages of growth in heifers under field condition in Kerala But a higher average daily weight gain of 660 g in

Ayrshire and 695 g in Friesian breeds were reported by Mantysaari *et al* 2002 Those in the present study of crossbred animals which were covered under SLBP had better weight gain when compared to animals reared under low and poor plane of nutrition The higher weight gain reported in exotic breeds were probably due to genetic and environmental factors The present study is in agreement with findings of Patel *et al* (1986) Rajeev (1998) and Trivedi and Patel (2004)

5 2 ATTAINMENT OF PUBERTY

Table 3 and Fig 2 showed that all the experimented animals had exh bited puberty prior to 21 months of age whereas in group II one animal between 19 21 months of age and one animal between 22 24 months of age exhibited puberty The overall age at puberty in group I animals were 448 68 ± 16 2 days and in group II were 645 days among the animals which exhibited puberty

The average age at puberty in Jersey x Bos indicus crossbreds was 22 9 ± 0 9 months Rao and Rao (1975) Balakrishna *et al* (1981) observed the first detected heat at about 679 days in Zeba x Holstein crossbreds According to Saxena (1991) age at puberty in crossbred heifers ranges between 633 to 987 days Sanae *et al* (1994) observed that age at puberty was ranging between 8 18 months in exotic breeds and 24 30 months in Indian breeds However Bramhaiah (2004) reported age and body weight at puberty in Punganur cattle was 827 86 ± 48 13 days and 109 000 ±3 51 kg respectively

Better feeding and efficient management were essential to avoid adverse effect of fertility in dairy cattle (Gujarand Shukla 1990 Karche and Goutan 1991 Billante *et al* (1991) Deresz (1992) and Andrada (1992) Similarly many authers had reported the role of adequate nutrition for the early attainment of onset of oestrus in heifers (Billante *et al* 1991 Deresze 1992 Hafman and Funke 1992 Patterson *et al* 1992 Keith *et al* 1992)

According to Sange *et al* (1994) the average age at puberty in exotic heifers ranged between 8 to 18 months and 24 to 30 months in Indian heifers of well defined breeds Rajeev (1998) found that 73 3 per cent of heifers exhibited early onset of puberty with moderate plane of nutrition But in animals with poor and low plane of nutrition only 22 7 per cent exhibited puberty in a field study conducted in Kerala

In the present study all the animals covered under SLBP attained puberty prior to 21 months of age supporting this view of Cicciolı *et al* (2005) and Gassar *et al* (2006) who reported that better plane of nutrition and management hasten the onset of puberty

5 3 ATTAINMENT OF MATURITY

In group I 3(13 63%) 10(45 45%) 5(22 72%) 2(9 1%) and 2 (9 1%) animals prior to 12 months of age 13 15 months of age 16 18 months 19 21 months and 22 24 months of age respectively attained maturity (Table 4 and Fig 3) Thus it could be seen that all the 22 (100%) animals covered under SLBP attained maturity prior to 24 months of age whereas only 2 out of 11 (18 2%) reached maturity among control animals This supports the view that better feeding management and health care improved the attainment of maturity in heifers covered under SLBP

The overall age at maturity by 24 months of age in group I were 515 09 ± 15 06 days whereas in group II animals were 686 days There was significant (P<0 01) difference in age at maturity between the two groups

Various workers supported the view that better feeding better management and health care hastened the onset of sexual maturity of heifers (Murdia 1990 Sane *et al* 1994 Abdulla *et al* 1994 Sejrsen *et al* 1997 and Saijpoul *et al* 1999) Nutritional deficiency played a key role in retarded growth and development of genital organs resulting in nonfunctional ovaries in crossbred heifers (Mathur *et al* 2005) In the present study nutritional deficiency poor management and poor health care were attributed as the major reasons for delayed puberty and maturity in animals which are not covered under SLBP On the other hand all the animals which are covered under SLBP attained maturity by 21 months of age clearly emphasizing the role of better feeding management and health care in augmenting fert lity

5 4 AGE AT CONCEPTION

It is observed that a total of 14 (63 6 per cent) in group I whereas only 2 (18 2 per cent) in group II conceived by 24 month of age The overall age of conception in group I experimental animal was 619 79 ± 22 66 days whereas in group II control animals it was 716 days There was higher level of significant (P<0 01) difference in overall age at concept on between these two groups

The age at first conception was found to be highly varying among crossbred cattle of India (Patel *et al* 1986 Patel and Dave 1987 Patel *et al* 1989 and Trivedi and Patel 2004) and among pure Jersey breeds (Muridia *et al* 1990) In the present study it was observed that a total of 14 (63 6 per cent) out of 22 heifers covered under SLBP conceived by 24 months of age But among animals not covered under SLBP only2 (18 2 per cent) conceived by 24 months of age It confirms that better feed ng management and health care was helpful n obta ning a good fertility among animals covered under SLBP

5 5 CONCEPTION RATE

The number of AI per conception in group I animals was 1 86 whereas in group II it was 2 5 There was significant difference (P<0 01) in number of AI per conception between these two groups

Different authors reported varying results in average number of AI per conception for different crossbred heifers in India (Patel *et al* 1986 Murdia and Trivadi 1990 Saijpoul *et al* 1999 and Misra *et al* 2001) The optimum number of AI per conception was reported to be 3 62 ± 0 44 2 58 ± 0 21 and 4 76

± 0 65 in Kankrej Jersey x Kankrej Holstein x Kankrej heifers (Patel *et al* 1986)

In the present study animals covered under SLBP conceived for 1 86 AI per conception which was a better fertility compared to 2 5 AI per conception in control groups

5 6 HAEMATOLOGICAL PARAMETERS

5 6 1 Haemoglobin (g per cent)

Normal value of Hb ranges from 8 0 to 150 g percentage (Blood *et al* (1989) In the present study mean value of haemoglobin in animals belonging to group I at 6th 12th and 18th month of age were 6 24 ± 0 25 9 8 ± 0 027 and 10 47 ± 0 19 and in group II animals were 6 36 ± 0 31 7 85 ± 0 18 and 7 86 ± 0 18 respectively Similarly Hb percentage of group I animals at puberty and maturity were 9 83 ± 0 25 and 9 78 ± 0 24 and in group II were 8 01 ± 0 17 8 22 ± 0 137 respectively (Table 6 and Fig 5) Statistical analysis revealed that the animals of group I had high level of significance (P<0 01) from 12th month to maturity when compared to the animals of group II

Shrivastava *et al* (1986) Sharma *et al* (1986) Awasthi *et al* (1989) and Singh *et al* (1998) found non significant difference in Hb percentage between the values at normal cycling and infertile heifers According to Nayyar (1998) no difference was observed in the haemoglobin valves between normal and delayed pubertal heifers which were born during winter and spring season However Koley *et al* (2004) observed that Hb concentration of anoestrus heifers increased significantly after mineral supplementation from 10 58 ± 0 10 to 11 02 ± 0 18 g% but had no significant variation with that of normal cycling heifers In Jersey crossbred heifers the mean value of haemoglobin in anoestrus and oestrus condition were 7 88 ± 0 63 and 11 54 ± 1 11 respectively after improving feed and managemental condition and deworming at regular interval The haemoglobin value at oestrus condition was highly significant (P<0 01) than in anoestrus condition (Das *et al* 2005) The haemoglobin content was lowest in young calves and increased with advanc ng age to reach highest level at puberty The low Hb content may be due to poor managerial care in calves and heifers compared to pregnant and lactating an mals The present study is an agreement with findings of Koley *et al* (2004) and Dhami *et al* (2005)

5 6 2 Packed Cell Volume (percentage)

Normal value of PCV ranged from 24 0 to 46 per cent (Blood *et al* 1989) In the present study mean value of packed cell volume in animals belong ng to group I at 6^{th} 12^{th} 18^{h} month of age were 24 50 ± 0 61 28 27 ± 0 63 and 30 89 ± 0 18 and in group II were 24 32 ± 0 67 24 64 ± 0 33 and 25 91 ± 0 51 respectively Similarly the PCV value of group I animals at puberty and maturity were 29 18 ± 0 49 and 30 09 ± 0 43 and in group II were 26 45 ± 0 31 and 26 73 ± 0 30 respectively (Table 6 Fig 6) The statistical analysis showed that group I animals had higher level of significance (P<0 01) from 12^{th} month of age to maturity when compared to animals of group II Various authors (Rao *et al* 1981 Gongwar *et al* 1984 Kumar *et al* 1985 Kumar and Sharma 1991 and Das 1993) reported s gnificantly higher value of PCV in normal healthy animals as compared to infertile animals However Khan *et al* (1995) Nayyar (1998) observed no significant change in regularly breeding cows as compared to infertile animals

The increased value of PCV in group I animals in the present study was in full agreement to the findings of Das *et al* (2005) who reported increased PCV due to improved feeding and management and regular deworming

5 6 3 Total Leucocyte Count (per mm^3)

The normal value of leucocyte count ranges from 4000 to 12000 (per mm^3) Blood *et al* (1989)

In the present study the mean value of TLC ın anımals belongıng to group I at 6th 12th and 18 h month of age were 6204 55 ± 373 79 5704 55 ± 407 77 and 5700 ± 0 512 and ın group II were 6090 91 ± 0 27 6090 91 ± 365 42 and 6218 18 ± 291 respectıvely Sımılarly TLC of group I anımals at puberty and maturıty were 5686 36 ± 33 09 and 5663 64 ± 26 76 and group II were 6218 18 ± 254 35 and 6272 73 ± 243 8 respectıvely (Table 6 Fıg 7) The statıstıcal analysıs revealed that group II anımals had a hıgher level of sıgnıficance (P<0 01) from 12th month to maturıty when compared to the an mals of group I But Prasad (1984) observed non sıgnıficant dıfference ın TLC value on the day of heat as compared to anoestrus state However Khan *et al* (1995) observed no sıgnıficant change ın TLC value between regular breedıng cows repeat breedıng and ın anoestrus cows On contrary Das *et al* (2005) observed sıgn ficantly hıgher TLC value ın anoestrus anımals agreeıng wıth observatıon ın the present study Hence ıt can ınferred that TLC value was lower ın anımals covered under SLBP whıch were reared under better feedıng and management condıtıon

5 6 4 Total Erythrocyte Count (Mıllıons per mm^3)

The normal value of RBC ranged from 5 0 to 10 0 mıllıon per mm^3 (Blood *et al* 1989)

In the present study the mean value of total erythrocyte count ın anımals belongıng to group I at 6th 12th and 18th month of age were 3 90 ± 0 27 6 44 ± 0 23 and 7 38 ± 0 29 and ın group II anımals were 3 33 ± 0 14 4 02 ± 0 181 and 4 45 ± 0 17 respectıvely Sımılarly the total erythrocyte count of group I anımals at puberty and maturıty were 6 46 ± 0 23 and 6 42 ± 0 04 and ın group II were 4 95 ± 0 23 and 5 05 ± 0 07 respectıvely (Table 6 and Fıg 8) The statıstıcal analysıs showed that group I anımals had hıgher level of sıgnıficance (P<0 01) from 12th month of age to maturıty when compared to anımals of group II The RBC count ın the present study were wıthın normal physıologıcal range (Blood *et al* 1989) The mean RBC count ın crossbred anımals were reported to be slıghtly hıgher than those ın natıve Gır Cows (Talvalkar *et al* 1980 and

Talvalkar *et al* 2005) Higher values of RBC were observed in buffaloes with better feeding and management (Ganguior *et al* 1984) and in Jersey crossbred heifers by Das *et al* 2005) However Khan *et al* (1995) observed that the mean RBC count did not show any significant in regular breeding cows repeat breeding and anoestrus cows

In the present study a higher RBC value was observed in animals covered under SLBP which agreement with findings of Das *et al* (2005) The difference in RBC could be attributed to better nutritional and managemental factors for these animals

5 7 BLOOD BIOCHEMICAL CONSTITUENTS

5 7 1 Calcium (mg per cent)

The mean value of calcium obtained in animals at 6th 12th and 18th month of age were 9 49 ± 0 17 9 73 ± 0 15 and 10 64 ± 0 14 and in group II were 9 63 ± 0 6 9 65 ± 0 18 and 10 53 ± 10 respectively (Table 7 and Fig 9) Similarly the mean value of calcium in group I animals at puberty and maturity were 10 01 ± 0 125 and 10 04 ± 0 124 and in group II were 10 04 ± 0 09 and 10 01 ± 0 07 respectively The statistical analysis revealed that there is no significant difference in the value of calcium between the two groups Calcium level in both groups were within the normal range of 8 to 10 5 mg percent (Blood *et al* 1989)

Roberts (1982) reported that calcium deficiency normally did not cause reproductive failure in cattle However variation in calcium level between cyclic and infertile cows were reported by few workers (Sharma *et al* 1984 Dabas *et al* 1987 Rajeev 1998 Dutta *et al* 2001 and Chandrahar *et al* 2003)

On contrary Ramakrishna (1996) and Das *et al* (2002) observed no significant difference in the value of serum calcium between healthy and infertile animals However Dhami *et al* (2005) reported decline in calcium level as advancing age till maturity which was not noticed in the present study It could be concluded that serum calcium level was not changing between the two groups at any stage of growth confirming that mild variation in calcium level is not influencing the reproductive status of heifers

5 7 2 Phosphorus (mg per cent)

The mean value of phosphorus in animals belonging to group I at the age of 6th 12th and 18th month were 4 5 ± 0 139 5 07 ± 0 103 and 5 31 ± 0 109 and in group II were 4 12 ± 0 127 3 88 ± 1 103 and 4 02 ± 0 09 respectively (Table 7 and Fig 10) Similarly the phosphorus level in group I animals at puberty and maturity were 5 18 ± 0 07 and 5 30 ± 0 09 and in group II were 4 07 ± 0 05 and 3 98 ± 0 05 respectively The statistical analysis revealed that the group I animals had higher level of significance compared to group II animals from 12th month of age to maturity

Different authors conclusively reported variation in serum phosphorus level between healthy and infertile animals and was attributed as a major reason for reproductive problems in cattle (Sharma *et al* 1984 Dabas *et al* 1987 Das 1993 George 1995 Shrivastava and Kadu 1995 Ramakrishna 1996 Singh and Pant 1998 Rajeev 1998 Dutta *et al* 2001 Das *et al* 2002 Chandrahar 2003 Bearden *et al* 2004 Yadav 2004 and Rothour *et al* 2005)

In the present study it could be concluded that the serum phosphorus level were significantly lower in animals which were not covered under SLBP probably due to poor feeding and management Further it could be inferred that phosphorus deficiency in growing heifers would result in delayed puberty and maturity

5 7 3 Iron (ppm)

The mean value of Iron in animals belonging to group I at the age of 6th 12th and 18th month were 1 06 ± 0 007 1 51 ± 0 122 and 1 00 ± 0 002 and in group II were 1 04 ± 0 062 0 99 ± 0 08 and 0 97 ± 0 05 respectively (Table 7 and

Fig 11) Similarly the values in group I animals at puberty and maturity were 1 44 ± 0 11 and 1 49 ± 0 12 and in group II were 1 01 ± 0 04 and 1 04 ± 0 04 respectively The statistical analysis revealed that group I animals have higher level of significance compared to group II animals

The mean serum iron content were reported to be varying between healthy and infertile animals (Parmer *et al* 1986 Singh and Pant 1998 Das *et al* 2002 and Kavane *et al* 2005) On contrary Khasatiya *et al* 2005 could not observe any significant difference in mean plasma levels in between fertile and infertile buffaloes In the present study it could be observed that the animals covered under SLBP (Group I) had a better growth and weight gain attributed to better feeding resulting in an elevat on of iron content in the blood stream

5 7 4 Cobalt (ppm)

The mean value of cobalt in animals belonging to group I at the age of 6th 12th and 18th month were 0 26 ± 0 006 0 22 ± 0 002 and 0 23 ± 0 002 and n group II were 0 16 ± 0 02 0 16 ± 0 02 and 0 17 ± 0 02 respectively (Table 7 and Fig 12) Similarly the values in group I at puberty and maturity were 0 32 ± 0 005 and 0 33 ± 0 006 respectively and in group II were 0 26 ± 0 20 and 0 25 ± 0 01 respectively The statistical analysis showed that group I animals had higher level of significance at 18th month of age and at maturity compared to group II animals

The mean serum cobalt level was reported to be highly varying between normal and infertile animals (Vhora *et al* 1995 Khasatiya *et al* 2005) but mild variation reported by George (1995) Further Bearden *et al* (2004) stated that copper and cobalt deficiencies were mostly associated with depressed oestrus low fertility and abnormal fetal development In the present study it could be concluded that better feeding and management in animals covered under SLBP might have resulted in signifying increase in serum cobalt level favouring increased fertility

5 7 5 Copper (ppm)

The mean value of copper in animals belonging to group I at 6^{th} 12^{th} and 18^{h} month of age were 0 53 ± 0 003 0 55 ± 0 003 and 0 55 ± 0 004 and in group II were 0 39 ± 0 07 0 38 ± 0 03 and 0 38 ± 0 02 respectively (Table 7 and Fig 13) Similarly the values in animals belonging to group I at puberty and maturity were 0 54 ± 0 046 and 0 51 ± 0 04 and in group II were 0 42 ± 0 02 and 0 41 ± 0 01 respectively The statistical analysis had revealed that group I animals had h gher significance compared group II

Many authors reported that the serum copper level was higher in healthy as compared to infertile animals (Parmer *et al* 1986 Daber *et al* 1987 Saxena *et al* 1991 Vhora *et al* 1995 George 1995 Rajeev 1998 Das *et al* 2002 and Kavani *et al* 2005) However Dutta *et al* (2002) and Singh *et al* (2004) could not observe any significant variation in copper level between normal and infertile cattle and buffaloe heifers respectively Hence n the present study it could be observed that the serum copper level was significantly higher in animals covered under SLBP

5 7 6 Zinc (ppm)

The mean value of zinc in animals belonging to group I at 6^{th} 12^{h} and 18^{th} month of age were 0 68 ± 0 003 0 62 ± 0 005 and 0 66 ± 0 004 and in group II were 0 66 ± 0 24 0 61 ± 0 05 and 0 66 ± 0 04 respectively (Table 7 and Fig 14) Similarly the values in animals belonging to group I at puberty and maturity were 0 73 ± 0 07 and 0 77 ± 0 057 and in group II were 0 71 ± 0 03 and 0 76 ± 0 03 respectively The statistical analysis revealed that there is no s gnificant difference in the zinc level between the group I and II at any stage of growth

Saxena *et al* (1991) reported higher serum zinc level in heifers exh biting oestrus in less than 750 days compared to those exhibiting later Dutta *et al* (2002) and Das *et al* (2002) reported significantly higher zinc level in cyclic anımal as compared to ınfertıle anımals However statıstıcally ınsıgnıficant varıatıon was reported by George (1995) Rajeev (1998) Shah *et al* (2003) and Sıngh *et al* (2004) Further Reece (2004) stated that zınc deficıency alters the synthesıs of prostaglandın whıch may affect reproduct ve functıon

The present study confirms that zınc level was not altered sıgnıficantly durıng dıfferent phase of growth ın both experımental and control groups

5 7 7 Manganese (ppm)

The mean value of manganese ın anımals belongıng to group I at 6th 12th and 18th month of age were 0 04 ± 0 001 0 03 ± 0 001 and 0 03 ± 0 003 and ın group II were 0 04 ± 0 003 0 03 ± 0 001 and 0 03 ± 0 02 respectıvely (Table 7 and Fıg 15) Sımılarly the values ın anımal belongıng to group I at puberty and maturıty were 0 081 ± 0 03 and 0 09 ± 0 02 and ın group II were 0 08 ± 0 04 and 0 09 ± 0 03 respectıvely The statıstıcal analysıs revealed that there ıs no sıgnıficant dıfference ın the manganese level between the two groups at any stage of growth

The plasma manganese level was reported to be hıgher ın healthy anımals as compared to ınfertıle anımals (Parmer *et al* 1986 Dutta *et al* 2002 Khasatıya *et al* 2005) On contrary plasma manganese level was reported to be lower ın healthy than ın ınfertıle an mals (Das *et al* 2002 and Shah *et al* 2003)

Reproductıve dısorders lıke anoestrus poor follıcular development delayed ovulatıon sılent oestrus and reduced conceptıon rate were produced due to manganese deficıency (Arthur *et al* 2001) In the present study there was no sıgnıficant varıatıon ın manganese level between the two groups and the manganese level was found wıthın the normal range

The present study revealed that better feedıng management and health care provıded through SLBP ımplemented by AHD Department was useful for brıngıng down the age at puberty to 448 68 days and to maturıty 515 90 days and to obtain satisfactory conception rate of 1 86 AI per conception The better feeding provided through the scheme resulted in elevating the Hb PCV and total erythrocyte count in animals covered under SLBP at different stages of growth and at puberty and maturity Similarly the serum phosphorus iron copper and cobalt level were found significantly improved in these animals picturing the importance of SLBP scheme implemented by Animal Husbandry Department

Summary

6 SUMMARY

The present investigation was carried out to study the influence of better feeding management and health care of calves selected under Special Livestock Breeding Programme (SLBP) implemented by Animal Husbandry Department of Kerala Twenty two calves which were covered under SLBP and 11 calves which were not covered under SLBP both belonging to farmers below poverty line of Anthikad Villadom and Ollukkara Villages of Trichur District were selected at random to form group I and II respectively

Group I animals were fed with good quality compounded cattle feed supplied to farmers at 50 per cent subsidized rate from Department of Animal Husbandry and provided extension support adequate health and insurance cover Group II animals maintained by poor farmers under field condition and their feeding and management were fully dependent on the interest and capability of the farmers

The mean body weight of animals belonging to group I at 6^{th} 12^{th} 18^{th} at puberty and maturity were 68 32 ± 0 88 116 59 ± 0 94 178 36 ± 1 36 165 5 ± 0 08 and 174 55 ± 1 7 kg respectively whereas in group II were 69 36 ± 1 00 83 26 ± 0 84 102 16 ± 0 29 155 26 ± 0 29 and 165 24 ± 0 2 kg respectively Statistical analysis revealed that group I animals had a higher level of significance compared to group II The daily weight gain of animals belonging to group I and II from 6^{th} to 12 month of age were 268 22 g per day and 77 2 g per day respectively and that from 12^{th} to 18^{h} month of age were 343 16 and 105 g per day respectively This shows group I animals had a significantly higher body weight and daily weight gain compared to group II

All the animals in group I (100 per cent) exhibited puberty and maturity before 24 months of age whereas in Group II only 2 (18 2 per cent) attained puberty and maturity by 24 months of age The overall age at puberty in group I was 448 68 ± 16 20 days whereas in group II it was 645 days The overall age at maturity in group I was 515 09 ± 15 06 days whereas in group II it was 686 days among those animals attained maturity

In group I a total of 14 (63 60%) out of 22 and in group II only 2 (18 2%) out of 11 conceived by 24 months of age

The overall age at conception in group I animals was 619 79 ± 22 days whereas in group II animals it was 716 days The number of AI per conception in group I animal was 1 86 whereas in group II was 2 5 The heifers covered under SLBP attained puberty and maturity at an early age and obtained a higher conception rate compared to control group

Haematological parameters such as haemoglobin packed cell volume total leucocyte count and total erythrocyte count were estimated in all the animals at different stages of growth and at puberty and maturity The Hb percentage of group I animals at puberty and maturity were 9 83 ± 0 250 and 9 78 ± 0 240 and group II were 8 01 ± 0 170 and 8 22 ± 0 137 g% respectively The PCV value of group I animals at puberty and maturity were 29 18 ± 0 49 and 30 09 ± 0 43 and in group II were 26 45 ± 0 31 and 26 73 ± 0 30 per cent respectively The TLC value in group I at puberty and maturity were 5686 36 ± 33 09 and 5663 64 ± 26 76 and in group II were 6218 18 ± 254 35 and 6272 73 ± 243 80 per mm^3 respectively The total erythrocyte count of group I animals at puberty and maturity were 6 46 ± 0 23 and 6 42 ± 0 04 and in group II were 4 95 ± 0 23 and 5 05 ± 0 07 million per mm^3 respectively The mean haemoglobin value packed cell volume total erythrocyte count were found to be significantly higher n group I animals whereas the total leucocyte count was found to be significantly higher in group II

The blood biochemical const tuents like calcium copper iron cobalt zinc and manganese were estimated by Perkin Elmer atomic absorption spectrometry and phosphorous by colourimetry The serum phosphorus level in group I animals at puberty and maturity were 5 18 ± 0 70 and 5 30 ± 0 90 and group II were 4 07 ± 0 05 and 3 98 ± 0 05 mg% respectively The serum iron level (ppm) in group I animals at puberty and maturity were 1 44 ± 0 110 and 1 49 ± 0 120 and in group II were 1 01 ± 0 040 and 1 04 ± 0 040 respectively The serum cobalt level (ppm) in group I and II at puberty and maturity were 0 32 ± 0 005 0 33 ± 0 006 and 0 26 ± 0 200 and 0 25 ± 0 010 respectively The serum copper level (ppm) in group I and II at puberty and maturity were 0 54 ± 0 046 0 51 ± 0 040 and 0 42 ± 0 020 and 0 41 ± 0 010 respectively The serum phosphorus iron cobalt and copper level were found to be significantly higher in group I whereas there was no significant difference in serum calcium zinc and manganese between the two groups

The present study revealed that better feeding management and healthcare provided to animals covered under SLBP implemented by AH Department was useful for better growth for bringing down the age at puberty to 448 68 days and maturity to 515 90 days and to obtain satisfactory conception rate of 1 86 AI per conception Since the SLBP was found to be well accepted by poor farmers this scheme may be extended to a wide population for improving the cattle wealth of our state

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REPRODUCTIVE PERFORMANCE OF CROSS BRED HEIFERS UNDER SPECIAL LIVESTOCK BREEDING PROGRAMME OF KERALA

N SATHYARAJ

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Kerala Agricultural University Thrissur

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Department of Animal Reproduction, Gynaecology and Obstetrics
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY THRISSUR 680651
KERALA INDIA

ABSTRACT

The study was conducted to assess the influence of better feeding and management of calves selected under Special Livestock Breeding Programme (SLBP) implemented by the Department of Animal Husbandry of Kerala Twenty two calves which were covered under SLBP and 11 calves which were not covered under SLBP were selected at random to form group I and II respectively All the animals in both groups belonged to the farmers below poverty line (BPL) of Anthikad Villadom and Ollukkara Villages of Thrissur District

Group I animals were fed with good quality compounded cattle feed supplied to farmers at 50 per cent subsidized rate from Department of An mal Husbandry and provide extension support adequate health and insurance cover These animals were closely monitored at monthly intervals and were dewormed at regular intervals

Group II animals were maintained by poor farmers under field condition and their feeding and management were fully dependent on the interest and capability of the farmers

The body weight of all animals in group I and II were recorded at 6^{th} 12^{th} and 18^{th} month of age and at puberty and sexual maturity The mean body weight in animals belonging to group I at 6^{th} 12^{th} and at 18^{th} month of age and at puberty and maturity were 68 32 ± 0 88 116 59 ± 0 94 and 178 36 ± 1 36 165 5 ± 0 08 and 174 55 ± 1 7 kg and in group II were 69 36 ± 1 0 83 26 ± 0 84 and 102 16 ± 0 29 155 26 ± 0 29 and 165 24 ± 0 2 kg respectively The daily weight gain of animals belonging to group I and II from 6^{th} to 12^{th} month of age were 268 22 g per day and 77 2 g per day respectively and that from 12^{h} to 18^{h} month of age were 343 16 and 105 g per day respectively Statistical analysis revealed that group I animals had higher level of significance (P<0 01) compared group II animals

It was found that all the animals in group I exhibited puberty before 21 months of age while only 2 (18 2 per cent) exhibited puberty in control group by

24th month of age The overall age at puberty in group I experimental animals were 448 68 ± 16 20 days whereas in group II animals were 645 days Similarly all the experimental animals in group I reached maturity by 24th month of age while only 2 (18 2%) reached maturity in control group The overall age at maturity in group I experimented animals was 515 09 ± 15 06 days whereas in group II animals it was 686 days There is higher level of significance in age at puberty and maturity between these two groups

A total of 14 (63 6%) in group I whereas only 2 (18 2%) in group II conceived by 24 h month of age The overall age at conception in group I experimental animals was 619 ± 22 66 days whereas in group II control animals it was 716 days The number of AI per conception in group I an mals was 1 86 whereas in group II was 2 5 The heifers covered under SLBP had reached puberty and maturity at an early age and obtained a higher conception rate when compared to control group

Haematological parameters such as haemoglob n packed cell volume total leukocyte counts and total erythrocyte counts were estimated in all the an mals at 6th 12th and 18th month of age and at puberty and maturity It was found that all the haematological parameters except leukocytes counts were significantly higher in group I animals from 12 h month of age to maturity compared to group II animals

The blood biochemical constituents like calcium copper iron cobalt zinc and manganese were estimated by Perkin Elmer Atomic Absorption Spectrophotometry and phosphorus by colourimetry The serum phosphorus iron cobalt and copper were found to be significantly higher in group I whereas there was no significant difference in serum calc um zinc and manganese levels between the two groups

It is concluded that calves enrolled under SLBP implemented by AH Department of the State attained puberty and matur ty at an early age and yielded a satisfactory conception rate under field conditions