EFFECT OF DIFFERENT DIETARY LEVELS ON THE POSTPARTUM REPRODUCTIVE PERFORMANCE OF CROSS-BRED COWS

By

M. I. ALEXANDER

THESIS

Submitted in partial fulfilment of
the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Reproduction
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy - Trichur

1983

DECLARATION

I hereby declare that this thesis entitled "EFFECT OF DIFFERENT DIETARY LEVELS ON THE POSTPARTUM REPRODUCTIVE PERFORMANCE OF CROSS-BRED COWS" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

Mannuthy,
28-2-1983.

M.I. ALEXANDER.

CERTIFICATE

Certified that this thesis entitled "EFFECT OF DIFFERENT DIETARY LEVELS ON THE POSTPARTUM REPRODUCTIVE PERFORMANCE OF CROSS-BRED COWS" is a record of research work done independently by Sri.M.I.Alexander under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

K Prabhakaran Nair

DR. K. PRABHAKARAN NAIR
CHAIRMAN, ADVISORY BOARD
ASSOCIATE PROFESSOR IN CHARGE OF PROFESSOR
DEPARTMENT OF ANIMAL REPRODUCTION.

Mannuthy,
-2-1983.

Dedicated to the ever loving memory of my beloved teacher Dr C K S V RAJA who had endeared himself to his students and colleagues alike by his ingenuous intimacy, disarming demeanour, erudite wisdom and above all as a paragon among gentlemen

ACKNOWLEDGEMENTS

Dr.K. Prabhakaran Nair, Associate Professor in charge of Professor, Department of Animal Reproduction and Chairman of the Advisory Board has been a constant source of succour and inspiration to me by his vast erudition, quick wit and untiring perseverance. But for his ardent encouragement, stable support and friendly guidance I would not have succeeded in finishing this project within the time bound. And so I express my sincere gratitude to him.

Dr.E. Mathai, Dr.E. Madhavan, Associate Professors, Department of Animal Reproduction and Dr.P.A. Devassia, Associate Professor, University Livestock Farm, Mannuthy; Members of the Advisory Board, were ever ready with valuable suggestions and have evinced pervasive interest in the trial. Association of their ideas and experience many a time led to the synthesis of solution. I rever them with gratitude.

I wish to express my thanks to Dr.M. Krishnan Nair, Dean, Faculty of Veterinary and Animal Sciences for providing facilities for the study.

My thanks are due to Dr.C.T.Thomas, Associate Professor, Department of Animal Nutrition; Dr.M.R.Sasindranath, Junior Assistant Professor, Department of Medicine and Dr. Stephan Mathew, Junior Assistant Professor, University Livestock Farm, Mannuthy for their never failing help.

I am very much indebted to Dr. P.U. Surendran, Professor and Head of the Department of Statistics and to Sri. N. Ravindran, Assistant Professor, Department of Statistics for the help rendered in statistical analysis of the data. I record my feeling of gratitude to them.

I wish to express my thanks to the Government of Kerala for awarding deputation for postgraduate studies.

Dr. P.K. Nambiar, Director of Animal Husbandry has been the soul and spirit of the Department of Animal Husbandry, Kerala ever since he became its head. He has been very kind to create opportunity to undertake postgraduate studies and I register my deep sense of gratitude to him.

I express my gratefulness to all the members of the staff of the Department of Animal Reproduction and the University Livestock Farm, Mannuthy for affable association and co-operation.

My thanks are due to Sri. T.D. Jose, College of Veterinary and Animal Sciences for typing the manuscript.

I am also thankful to Sri. T.K. Gopalan, Department of Poultry Science for help rendered.

My fellow students Dr. P.K. Naveen and Dr. R. Rajagopalan Nair have been my friends and colleagues for the last two decades. They have always endeavoured to extend helping hands without murmur. The cool shadow of our association has been very much invigorating and rewarding. To them I take my hat off.

And last but not least I record my heartfelt thanks to my wife Baby for inspiration and persuasion.

M.I. ALEXANDER.

TABLE OF CONTENTS

LIST OF TABLES

Table No.

Table No.

Table No.

LIST OF ILLUSTRATIONS

INTRODUCTION

INTRODUCTION

One of the most effective enterprises to augment the income and thereby improve the lot of the marginal farmer is no doubt dairy farming. There is unequivocal evidence to prove that dairy farming can never be a profitable proposition unless the animals are endowed with satisfactory production potential. The notoriously poor indigenous cattle of Kerala have been systematically graded up during the last couple of decades by a massive cross-breeding programme, launched during the turn of the latter of half of the century with the declared objective of improving the rural biased socio-economic status of the people at large. In spite of great constraints in the operation of the programme, it has been possible to considerably improve the genetic make up of our animals to the level of economic milk production.

The threshold of change in the genetic profile of our dairy animals leaves many a problem to reckon with. Reproductive inefficiency in cross-breds is generally considered to be the most expensive and frustrating hazard faced by the farmer.

The success of any dairy enterprise depends greatly on reproductive efficiency of the animals. It is considered that a cow giving one calf every year is at the peak of reproductive efficiency. This target can never be achieved unless the postpartum oestrous interval and service period are the shortest and the number of inseminations required per conception is the lowest.

Nutritional status of the animal during the initial lactation period plays a significant role in the postpartum reproductive performance. A reduced dietary intake would naturally result in a negative nitrogen and negative energy balance, thus inducing the animal to lose weight and cause delayed expression of postpartum heat.

Though there are numerous reports on the influence of dietary levels on body weight and postpartum reproductive performance of pure-bred cows and cross-bred heifers, there appears to be a paucity of data on cross-bred cows. Research on this specific aspect would give some insight into the actual level of nutritional requirement of cross-breds to meet the need of both lactation and reproduction. The present study is taken up with this objective in mind.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The importance of plane of nutrition on various aspects like age and weight at puberty, onset of postpartum heat, fertility rate and service period in both beef and dairy cattle had been extensively reported (Moustgaard, 1969; Boyd, 1970; Roberts, 1971; King, 1971; Arthur, 1975; Rattray, 1977; Deshpande et al. 1981; Kodagali, 1981). Perusal of these reports revealed a paucity of information on the effect of dietary levels on the postpartum reproductive performance of cross-bred cows.

Crichton et al. (1959) found that switch over of the plane of nutrition from high to low in growing heifers had adverse effect on growth and sexual maturity. Joubert (1963) recorded that age at puberty was markedly influenced by the plane of nutrition. A low plane of nutrition both qualitatively and quantitatively retarded the age at first oestrus in heifers. Similar views were expressed by various other workers also (Carroll and Hoelein, 1966; King, 1971; Dedeckova - Salova, 1974; Mathai and Raja, 1976; Velhankar, 1978a). Roberts (1971) stated that depending upon the level of feed intake, heifers showed oestrus from 7 to 18 months. Topps (1977) recorded that the main effect of undernutrition in the growing heifers was delayed onset of sexual activity. According to him there was good evidence to show that body weight was the major factor which influenced puberty. Rattray

(1977) opined that the level of nutrition by influencing the growth rate and time taken to reach the genetically determined weight had affected the age at which cattle reached puberty.

There exists a close linkage between body weight gain and reproductive performance of heifers. Baker (1967) recorded significantly greater relationship between body weight and oestrous activity in heifers of higher body weight. Lamond (1970) opined that the percentage of conception increased when heifers reached a genetically determined target weight. Dawson (1970) explained that growth and adult weight gain depended on protein and carbohydrate intake. He further stated that decline in body weight or scarcely perceptible growth rate adversely influenced reproductive potential. Gleeson (1972) found that success of mating heifers was more closely related to body weight than to age. Donaldson et al. (1977) had similar observation in their study on cross-bred beef heifers.

The level of nutrition had great bearing on rate of growth and reproductive performance. Rowes and Hentges (1963) recorded that low plane of nutrition significantly depressed growth. Bedrak et al. (1966) reported that the beef heifers receiving higher level of crude protein had rapid growth rate and good conception whereas, those which got lower level of protein had poor growth rate and failure of conception. Penzhorn and Femm (1973) revealed that when Africander heifers were fed either hay alone or were not hand fed at all, none conceived but when hay was supplemented with protein 71.4 per cent of the heifers conceived. Dedeckova Balova (1974) found that heifers which received standard ration had better conception rate than those which were fed at lower levels. Axelson and Morely (1976) recorded that cross-bred heifers on higher plane of nutrition had better conception rate. Mathai and Raja (1976) reported that Jersey-Sindhi cross-bred heifers receiving higher plane of nutrition attained puberty earlier. Boyd (1977) got clear-cut experimental evidence to show that the level of feeding especially dietary energy intake had significant effect on ovarian activity and oestrus in heifers. Leaver (1977) noted that increasing the plane of nutrition of dairy heifers in poor or moderate condition enhanced pregnancy rate, while there was a non-significant decline in pregnancy rate of heifers in good or very good condition.

Higher plane of nutrition, though important for better reproductive performance, may not give the same desired result in all situations. Warnick et al. (1965) raised cross-bred heifers on separate pastures under two levels of protein supplementation for a period of two years. They reported that reproductive performance of heifers was not greatly influenced by protein supplementation. Ishii et al. (1980) in a trial on Japanese Black cattle observed that the group of heifers which received standard ration weighed less at ten months of age than those given 160 per cent of standard ration. However, the difference in body weight disappeared at 15 months of age and there was no significant difference in the reproductive performance between groups.

Perusal of reports revealed wide variation in the interval between parturition and first observed heat. Chapman and Casida (1937) noted that the interval from calving to first postpartum oestrus was 69.30 ± 38 days in Holstein-Friesian cows. In Hereford cows Warnick (1955) observed a postpartum oestrous interval of 61.40 days. Trimberger (1956) found 50.20 days as the postpartum oestrous interval in Brown-Swiss cows. In Jersey cows Fallon (1958) reported a mean postpartum interval of 40 ± 23 days. Francis and Raja (1971) recorded the average postpartum oestrous interval as 103 days in Sindhi cows. Nair (1979) reported 52.40 ± 3.86 days as postpartum oestrous interval in Jersey cross-bred cows which had normal parturition. Bhaskaran et al. (1982) found that the mean interval from calving to onset of oestrum in cross-bred cows gaining body weight was 48.58 ± 3.35 days as against 74.00 ± 7.86 days in those losing body weight.

The relationship between postpartum changes in body weight and fertility after calving had been widely reported (McTaggart, 1961; McClure, 1965; King, 1968; Baker, 1969; Topps, 1977; Patil and Deshpande, 1979, 1981; Deshpande <u>et al</u>., 1981). McTaggart (1961), McClure (1965) and McClure and Dowell (1969) observed that there was marked loss of body weight during postpartum anoestrous period and a reduced conception rate to first service in pasture fed dairy cows. Swansen (1967) recorded a concurrent finding that animals losing weight had lower conception rate than those gaining weight. King (1968) reported that Ayrshire cows which gained body weight during the postpartum period had higher conception rate (77.6%) than those which lost weight (16%). The relationship between body weight gain and adequacy of diet for maintenance and production had been further stressed by King (1971). Lamond (1969) after examining nearly 15000 beef cows concluded that cows in poor body condition had a lower conception rate than those in fat condition. Baker (1969) reported that the plane of nutrition of postpartum cows influenced the body condition and postpartum oestrus. Lamond (1970) noted a positive correlation between body weight and fertility in postpartum cows. Similar observation was made by Hollon and Branton (1971) in dairy cows. They reported that cows which gained body weight during the postpartum period had 64 per cent conception rate as against 46 per cent conception in cows which lost body weight. Other workers have confirmed the above findings (Ward and Tiffin, 1975; Mulvehill and Sreenan, 1977; Youdan and King, 1977; Deas et al., 1979a; Patil and Deshpande, 1979, 1981; Deshpande et al., 1981; Bhaskaran et al. 1982). De vaccaro (1973) found that cows gaining weight prior to mating had higher rate of conception than those maintaining or losing weight. According to Arthur (1973) when the cow was put on a diet deficient in energy, it mobilised its own body reserve resulting in a decline in body weight. He further explained that cow exposed to negative energy balance was likely to become anoestrous or suboestrous.

Even though the positive correlation between postpartum weight gain and reproductive efficiency was widely acclaimed, there were also reports to the contrary. Richardson et al. (1976) found no relationship between calving percentage and the percentage change in body weight from postpartum to midway through mating season. Yadava et al. (1976) observed that the oestrous interval and conception after calving were not significantly affected by the difference in body condition. Nicol (1977) reported that though underfeeding reduced milk yield, it did not affect the calving intervals.

Proper feeding had always been regarded as an essential prerequisite for successful breeding and its effect on reproductive performance was widely accepted. Nevertheless, Wiltbank (1972) asserted that the nutritive requirement of cows following calving had not been well established. The requirement undoubtedly varies according to body size and milk production of cows. Many workers were of unanimous opinion that higher plane of nutrition enhanced reproductive performance of postpartum cows (Speth et al., 1962; Wiltbank et al., 1964; Ward, 1968; Dunn et al., 1969; Turton, 1969; Boyd, 1970). There were sufficient evidences suggestive of malnutrition being the cause of lowered postpartum fertility in cattle (McClure, 1968; Ward, 1968; Topps, 1977; Somerville, 1979; Kodagali, 1981). According to King (1971) the reproductive functions were susceptible to nutritional influences and hence dietetic error could be a cause for reproductive inefficiency. After several experiments Feoktistov (1972) concluded that protein content of the ration of recently calved cows should not fall below 110 to 112 gm/food unit for satisfactory reproductive performance. Brochart et al. (1972) and Sonderegger and Schurch (1977) observed that the reproduction of dairy cows was significantly influenced by the levels of energy and protein in the ration. Chaturvedi (1972) recorded that, even though rate of growth of Hariyana heifers under individual feeding was identical, sexual maturity was attained by 62 per cent of the animals under individual feeding as against 16 per cent in group feeding.

Cows maintained on a higher plane of nutrition, according to Foalman *et al.*(1973) required only fewer insemination per conception. Penzhorn and Kemm (1973), Drew (1977), Donaldson (1977), and Grainger and Wilnems (1978, 1979) observed a positive relationship between higher plane of nutrition and fertility in dairy cows. In an attempt to study the postpartum anoestrous condition and its causative factors in Gir cows Mokashi *et al.* (1974) gave extra concentrate and grass to 8 cows, while seven control animals were not given any supplements. In the treatment group seven out of eight cows showed postpartum oestrus within 90 days and six of them conceived whereas, in the control group only 2 out of 7 showed postpartum oestrus and only one of them conceived. Little (1975) maintained 3 groups of cross-bred pluriparous cows at 3 to 8 months of pregnancy on the rations supplemented with crude protein and phosphorus, phosphorus alone and no supplementation respectively. The group which got protein and phosphorus supplementation had the shortest interval for the onset of postpartum oestrus and the group which got no supplementation had the longest. McDonald (1975) explained that nutritional status of cattle during the postpartum pre-service period had marked influence on fertility at the first insemination. He added that deficiency of dietary energy was overlooked as a cause of postpartum or post-service anoestrus in dairy cows, even though lactating cows required higher levels of nutrients to maintain basal metabolism, bodily activities, reproduction and milk secretion. Fuquay et al. (1975), Chandler et al. (1976) and Saiko (1976) recorded similar response in cows when methionine or methionine analogue was given as a supplement. Methionine supplementation was found to shorten the period of postpartum anoestrus and service period. The number of services per conception was also reduced. According to Yadava et al. (1976) there appeared to be a trend for cows in poor condition to have oestrus after a long interval of time from calving than either medium or fat cows. He further stated that a low level of energy prior to calving tend to increase the interval from calving to first oestrus which could not be corrected by giving a higher level of energy after calving. Rattray (1977) reported that a negative energy balance could lead to reproductive failure by influencing oestrus, ovulation rate, fertilization rate, embryonic survival, prenatal loss and birth weight. Findings of many workers were in accord with the above conclusion (Boyd, 1977; Hughes et al., 1978). Inskeep and Lishman (1979) unraveled that the length of postpartum anoestrus in cattle varies with breed, age, plane of nutrition and intensity of suckling. Bond and Weiland (1978) found that raising the feed intake level prior to parturition had no effect on the postpartum oestrous interval and conception rate but significant improvement in the reproductive performance was observed when level of feeding was moderately increased after calving. In a review, Morrow (1980) concluded that nutrition and fertility were closely related in dairy cattle. Maximum reproductive performance was achieved when the ration balanced in respect of energy, protein, vitamins and minerals was fed to meet the requirements of animals for growth, maintenance and gestation.

Holness *et al.* (1980) established that both plane of nutrition and breed had significant effect on postpartum oestrus in Afrikander and Mashona cows. Plane of nutrition had a greater effect on calving rate than on the duration of postpartum anoestrus. Lopez and Martinez (1981) compared the effect of feeding of different supplementary levels of concentrates, on Holstein-Friesian heifers during the last 45 days of gestation and found that there was no significant difference in gestation length between different groups. But animals on higher plane of nutrition exhibited postpartum oestrus earlier than the other groups.

Even though positive correlation between higher plane of nutrition and increased postpartum reproductive performance was well documented, there were also reports to the contrary. Fuquay *et al.* (1966) and Gardner (1969) inferred that feeding a high energy ration during the early lactation period did not significantly alter the number of days required for the appearance of first postpartum oestrus and the number of services required per conception. Morrow et al. (1969) expounded that high producing liberally fed dairy cows were prone to a higher incidence of cystic follicles, prolonged intercalving period and poor fertility. According to Boyd (1970) lactating dairy cows were usually fed more grains than beef cattle but they did not share the fertility benefit from increased energy. Dronohart et al. (1972) and Sonderegger and Schurch (1977) even though approved the significant influence of energy on postpartum reproductive performance of dairy cows, cautioned that an abundant supplementation, lengthened the period for the appearance of postpartum oestrus. Similar apprehension had been expressed by Bond and Weiland (1978). According to deKruif (1978) nutrition was not an antidote for infertility. If nutrient requirement for maintenance, milk yield and gestation were met, those for reproduction would also be adequately covered. Jorden and Swanson (1979a, b) stated that feeding dietary protein in excess of that required by tissue caused cellular damage, resulting in unfavourable uterine or ovarian environment and reduction in fertility.

Various workers have indicated that higher blood levels of inorganic phosphorus, protein, glucose and haemoglobin had a profound influence on reproductive efficiency. It was assumed that elevated blood value was a ntural corollary of higher plane of nutrition.

According to the haematological data published by Blood et al. (1979) the normal range of inorganic phosphorus was 4 to 7 mg/dl. Hignett and Hignett (1951) inferred the existence of a close relation between phosphorus deficiency and bovine infertility. This inference was subsequently confirmed by other workers (Salisbury and VanDenmark, 1961; Boyd, 1970; King, 1971; Vujovic et al., 1972; Roberts, 1971; Cuenca, 1973; Maynard and Loosly, 1973; Sattar, 1973; Arthur, 1975; Morrow, 1977, 1980; Scharp, 1979; Murtuza et al. 1979; Deas et al. 1979b; Samad et al. 1980; Jainudeen and Hafez, 1980). There are numerous reports that addition of phosphorus in the diet could solve the problem of anoestrum and bring about a positive modulation of fertility in cattle (Morrow, 1970; Deshpande and Sane, 1977; Singh et al. 1978; Scharp, 1979; Samad et al., 1980; Jainudeen and Hafez, 1980). Sane (1972) recorded the mean serum inorganic phosphorus level as 5.20 mg/100 ml in anoestrous Gir cows. On the contrary, Pillai (1980) found the mean value of serum inorganic phosphorus as 4.05 mg/dl in anoestrous cows. Rao and Rao (1982) reported a significant increase in blood phosphorus level in cycling cross-bred heifers at the time of oestrus.

According to Hewett (1972) there existed a positive relationship between levels of serum protein and fertility. Deshpande et al. (1978) concluded that average value of serum protein in cows exhibiting oestrus was 7.90 g per cent but anoestrous cows never reached that level. The normal range of plasma protein according to Blood et al., (1979) was 6.00 to 8.50 g/dl. Patil and Deshpande (1979) observed that a decrease in blood protein level was related to anoestrus. Pillai (1980) found the mean serum protein in anoestrous heifers and cows to be 6.54 g/dl and 6.83 g/dl respectively.

Perusal of literature revealed wide variation in the value of blood glucose in cattle. Gonzaga and Vergara (1956) established that the blood glucose level of dry cows ranged from 43.11 to 63.29 mg/100 ml whereas, that of the lactating cows ranged from 23.48 to 90.91 mg/100 ml. According to Blood et al. (1979) the normal range of blood glucose was 35 to 55 mg/dl. McClure (1968) recorded that in cows which showed a conception percentage of 67 to 72, the blood glucose level ranged from 34.70 to 37 mg/100 ml, whereas in infertile cows the level was below 30 mg/100 ml. Various workers have reported that low blood glucose levels are associated with anoestrus and lower conception rates (McClure, 1970, 1972; Payne et al., 1970; Oxenreider and Wagner, 1971; Garden, 1975). Bhatia et al. (1972) reported that the value of blood glucose ranged from 57.10 to 79.90 mg/100 ml and 56.71 to 75.60 mg/100 ml respectively in Hariyana pure bred and cross-bred heifers. They further observed that the value decreased with age. Sane (1972) recorded the mean serum glucose level of anoestrous cows as only 39.40 mg/100 ml and claimed that the problem of anoestrum could be solved by increasing the serum glucose level to 53 mg/100 ml by feeding additional energy. Cuenca (1973) and Boyd (1977) made similar observations. Downie and Gelman (1976) unfolded a positive relationship between rise in level of plasma glucose and fertility in cows. They demonstrated a significant elevation of plasma glucose level in fertile cows and a decline in infertile cows. Velhankar (1978b) established that heifers which received a moderately elevated plane of nutrition showed higher blood glucose value (54.74 ± 4.89 mg%) and had better and consistent reproductive performance in terms of age and weight at puberty and sexual maturity, growth rate, ovulatory heat and pregnancy rate. Deshpande et al. (1978) expounded that the level of blood glucose is an important parameter to evaluate the reproductive status of the postparturient cow.

They further explained that in cows which exhibited oestrus during postpartum period the blood glucose level gradually increased from 48.00 to 57.14 mg per cent whereas, in those which did not show oestrus it decreased from 47.88 to 43.44 mg per cent. This finding was later confirmed by Patil and Deshpande (1979). Pillai (1980) observed a mean serum glucose level of 48.49 mg/dl and 51.60 mg/dl in anoestrous heifers and cows respectively. Rao and Rao (1982) observed significant increase in blood glucose level in cross-bred heifers during oestrus.

Morrow (1970) recorded that the haemoglobin percentage in anaestrous cows was below 9.80 g/100 ml compared to 10.60 g/100 ml in cows with normal oestrous cycle. The normal values published by Blood et al. (1979) ranged from 8 to 15 g/100 ml. Wagner (1972) analysed the data and found an apparent association between low haemoglobin level and anoestrum in dairy cows. According to Morrow (1977) the cows with haemoglobin levels varying from 10.20 to 10.78 g/100 ml bred earlier compared to those with a mean haemoglobin level of 9.1 g/100 ml. Pillai (1980) observed a haemoglobin level of 9.16 g/dl and 9.70 g/dl in anoestrous heifers and cows respectively.

MATERIALS AND METHODS

MATERIALS AND METHODS

The materials for the present investigation consisted of 30 cross-bred cows (Jersey X Sindhi, Jersey X local, Brown-Swiss X local) belonging to the University Livestock Farm, Mannuthy. Animals in advanced stage of pregnancy before completion of 270 days of gestation were selected for the study. The animals were weighed on the 270th day of pregnancy to obtain the prepartum body weight. All the animals were reared under identical feeding and management practices until parturition.

Immediately after calving the body weight of all animals was recorded and they were allotted in equal numbers at random to the three groups. The first group was treated as control and was given ordinary farm ration as per the Sen and Ray (1971) standard. The animals in the second and third groups assigned to treatments I and II were fed respectively 115 and 130 per cent ration fed to the control animals. During the entire course of the experiment, the animals were stall fed. Roughage was fed in the above proportion and water was given ad libitum to all the animals. All the experimental animals were regularly weighed at 15 days intervals from the day of parturition and also on the day of first postpartum heat. The data on the postpartum body weight and the number of days required for the onset of postpartum heat were compiled and analysed to find the effect of postpartum gain in weight on the onset of postpartum oestrus in the 3 groups (Snedecor and Cochran, 1967). The pattern of postpartum oestrus, such as duration and intensity of oestrum and time of ovulation were also studied in the experimental animals.

Data on the onset of postpartum oestrum of 71 cows in the herd not included in the experiment were compiled and compared with the data on the 3 experimental groups to find out the effect of management on the postpartum reproductive performance. The data on the milk yield for the first 60 days of lactation in respect of 71 cows in the herd and those of the experimental animals were collected and the lactational yield for 305 days calculated by multiplication with a factor 4.14 (Anon. 1973). The data were analysed statistically to find out the effect of higher plane of nutrition and management on the postpartum reproductive performance.

Five animals from each group were selected at random to estimate the serum phosphorus, protein, glucose and haemoglobin levels. Blood from selected animals was collected on the second day after parturition and thereafter at regular intervals of 15 days and also on the day of postpartum oestrum. Blood samples were collected between 10 to 10.30 AM to minimise variation.

About 10 ml of blood was collected into a test tube and allowed to clot. It was then centrifuged at a temperature of 10°C in a refrigerated centrifuge and the serum was collected in a test tube, labelled and kept under refrigeration for biochemical estimation of phosphorus, protein and glucose.

Inorganic phosphorus in serum was estimated as per Fiske and Subbarow (1925) and total protein in serum by Biuret method (Cornall <u>et al</u>., 1949). Serum glucose was estimated by O-Toludin method of Hultman (1959) modified by Dubowski (1962) and Hyravinen and Nikkila (1962).

Blood in 2 ml quantities was collected in a test tube containing a pinch of EDTA for estimation of haemoglobin. Cyanomethaemoglobin method (Benjamin, 1974) using an Erma Hemophotometer was adapted for the above estimation.

The data on biochemical estimation of serum inorganic phosphorus, protein, glucose and percentage haemoglobin were compiled and analysed (Snedecor and Cochran, 1967).

RESULTS

RESULTS

In order to understand the effect of different dietary levels on the postpartum reproductive performance of cross-bred cows, a detailed study was conducted using thirty cross-bred cows of the University Livestock Farm, Mannuthy. The animals were randomly allotted to three groups viz: control, treatment I and treatment II. The control animals were fed farm ration based on Sen and Ray Standard, whereas animals in treatment I and treatment II were fed respectively 115 and 130 per cent of the control ration. All the animals were weighed at 15 days interval from the day of calving to the day of postpartum oestrus. Blood was analysed for inorganic phosphorus, protein, glucose and haemoglobin once in every 15 days from 2nd day postpartum. During the course of the experiment one cow from treatment II fell sick and was removed from the trial. The study lasted from June to December, 1982.

The data on the prepartum and postpartum body weight of the control and the treatment groups are furnished in tables 1, 2 and 3. The animals in the control and treatment groups I and II weighed 355.70 $\pm$ 17.28, 335.10 $\pm$ 11.06 and 367.33 $\pm$ 16.96 kg respectively at 270th day of gestation. The postpartum body weight of the three groups at 0 day of calving were recorded to be 325.30 $\pm$ 15.85, 303.30 $\pm$ 10.51

and 333.77 ± 16.72 kg respectively indicating a steep decline (Fig.1, 2 and 3). The postpartum body weight of the control, treatment I and treatment II at 15, 30 and 45 days were recorded to be 317.30 ± 15.16, 314.50 ± 15.55, 315.70 ± 15.42 kg; 299.60 ± 11.00, 300.60 ± 10.62, 312.38 ± 11.80 kg; and 329.55 ± 16.38, 332.50 ± 16.13, 333.17 ± 16.07 kg respectively. The decline in body weight continued for the first fortnight in all the three groups, though at a reduced rate. The decreasing trend in body weight was maintained upto 30 days postpartum in the control animals, but in both the treatment groups the body weight showed a slightly increasing trend from 15 days postpartum onwards. In the control group the body weight almost levelled between 30 and 60 days postpartum and showed a steep upward trend only at 75 days. The treatment animals in which significant weight gain was noticed beyond 30 days postpartum, came to oestrus much earlier than the control. The mean body weight of control, treatment I and treatment II on the day of postpartum oestrus were 317.10 ± 15.5, 306.20 ± 12.29 and 334.42 ± 16.00 kg respectively and the postpartum oestrus intervals in the corresponding groups were 62.10 ± 4.63, 56.60 ± 5.53 and 53.22 ± 3.75 days respectively. Analysis based on one way classification to find out the effect of body weight on the postpartum oestrus in all the three groups revealed no significance (Table 4). However, it was observed that the animals in treatment II had the shortest postpartum oestrous interval, followed by animals in the treatment I. Analysis of the data on postpartum body weight of the corresponding stages revealed no significant difference between groups (Table 5, 6, 7, 8 and 9). So also, there was no significent differences between groups in regard to postpartum oestrous intervals (Table 10).

Since body weight changes in different groups were more manifest during 16 to 30 days postpartum, the data on the difference in body weight were worked out and analysed. It can be seen from table 11 that while the control animals lost weight, those in both the treatment groups gained weight. However, the coefficients of correlation between difference in body weight during days 16 - 30 postpartum and the postpartum oestrous intervals in all the three groups were not statistically significant. The co-efficients of correlation between groups were also not found to be significant.

During the course of study the duration of oestrus, intensity of oestrum and time of ovulation were observed. The grouped data are presented in table 12. Analysis of the data revealed that there is no significant difference between groups with respect to the duration of oestrus, intensity of oestrum and time of ovulation. The duration of oestrus ranged from 15 to 30 hours in all the cows except in a control cow which exhibited a short oestrum of 10 hours duration. The duration of oestrus in 23 cows ranged from 15 - 25 hours, whereas the remaining 5 animals had a longer oestrum of 25 - 30 hours. The intensity of oestrum was pronounced in 21 out of the total 29 cows brought under trial. Of these 8 belonged to treatment II, 7 to treatment I, and 6 to control. Medium heat was exhibited by only one animal in the control group. The time of ovulation ranged from 8 to 20 hours after the end of oestrus. Though majority of the animals ovulated between 12 to 20 hours postoestrus, 8 animals ovulated within the first 12 hours.

The data on the first postpartum oestrus of 71 cows in the herd were collected and compared with those of the experimental animals (Table 13). The postpartum oestrous interval of the herd was 82.50 ± 5.76 days as against 62.10 ± 4.63, 56.60 ± 5.53 and 53.22 ± 3.75 days for the control, treatment I and treatment II respectively (Fig.4). Statistical analysis revealed that there was significant difference between groups on the onset of postpartum oestrum ($P < 0.05$). Though T1 T2; T3 T4; and T2 T4 were homogeneous, T1 T3 and T1 T4 were found to be heterogeneous groups (Tables 13 and 14).

Table 13 presents data on the lactational yield of the herd, control, treatment I and treatment II. Though there is no significant difference in lactation yield between groups, the milk yield of control, treatment I and treatment II are found to be apparently higher than the herd average (Table 15).

The data on serum inorganic phosphorus of control, treatment I and treatment II are furnished in tables 16, 17 and 18 respectively. The serum inorganic phosphorus levels in control animals at 2, 15, 30 and 45 days post-partum were 4.66 ± 00.15, 4.48 ± 00.12, 4.80 ± 00.13 and 5.08 ± 00.09 mg per cent respectively. The corresponding levels for treatment I and treatment II were 4.42 ± 00.28, 4.38 ± 00.17, 4.68 ± 00.30, 4.60 ± 00.12 mg per cent and 4.62 ± 00.12, 4.64 ± 00.15, 4.44 ± 00.21, 4.88 ± 00.15 mg per cent respectively. The serum inorganic phosphorus levels on the day of oestrus were 5.18 ± 00.11, 5.44 ± 00.71 and 5.00 ± 00.11 mg per cent in the control, treatment I and treatment II respectively (Fig.5). Statistical analysis of data did not reveal any significant difference between the corresponding stages of the 3 groups (Tables 19, 20, 21, 22 and 23). The data on the inorganic phosphorus levels of three groups were regrouped and analysis carried out to find out whether there was any significant difference in the serum phosphorus levels before oestrum and on the day of postpartum oestrum. By applying normal standard error difference test (table 24) it was found that there was significant difference between the values before oestrum and on the day of oestrum in control ($P < 0.01$) and treatment II ($P < 0.01$).

The data on serum protein levels in respect of control, treatment I and treatment II are furnished in Tables 25, 26, and 27 respectively. The serum protein levels in control animals at 2, 15, 30 and 45 days postpartum were 8.37 ± 00.26, 8.16 ± 00.15, 8.19 ± 00.19 and 8.77 ± 00.19 g per cent respectively. The corresponding levels in respect of treatment I and treatment II were 7.80 ± 00.22, 7.83 ± 00.22, 8.13 ± 00.14, 8.21 ± 00.14 g per cent and 9.05 ± 00.35, 8.89 ± 00.17, 9.19 ± 00.22, 8.96 ± 00.32 g per cent (Fig.6) respectively. The serum protein levels on the day of oestrus were 9.22 ± 00.20, 8.28 ± 00.08 and 9.09 ± 0.17 g per cent in the control, treatment I and treatment II groups respectively. Statistical analysis by one way classification between the same stages of the 3 groups revealed significant difference on 2, and 30 days postpartum and on the day of oestrus (Tables 28, 29, 30, 31 and 32). Pairwise comparison of data on serum protein at 2nd day postpartum revealed that only treatments I and II were heterogeneous. On the other hand at 30 day postpartum the control and treatment I were found to be heterogeneous ($P < 0.05$) while all others were homogenous groups. On the day of oestrus heterogeneity was observed between control and treatment I; and treatment I and treatment II. Application of normal standard error difference test (Tables 33) revealed significant difference in the values prior to oestrum and on the day of postpartum oestrum in both control ($P < 0.01$) and treatment I ($P < 0.05$).

The serum glucose levels of control, treatment I and treatment II are presented in table 34, 35 and 36 respectively. The levels of serum glucose in control animals at 2, 15, 30 and 45 days postpartum were 57.40 ± 5.60, 53.42 ± 3.98, 54.98 ± 2.43 and 53.02 ± 1.77 mg per cent respectively. The corresponding levels for treatment I and treatment II were 55.51 ± 4.26, 50.58 ± 4.92, 36.55 ± 6.09, 53.08 ± 2.47 mg per cent and 63.08 ± 4.07, 57.22 ± 2.75, 54.90 ± 1.50, 57.85 ± 1.86 mg per cent respectively. The serum glucose levels on the day of oestrus were 57.20 ± 2.75, 61.04 ± 3.58 and 60.94 ± 2.19 mg per cent in the control, treatment I and treatment II respectively (Fig.7). Statistical analysis of the data by one way classification revealed no significant difference between corresponding stages of the 3 groups, except at 30 days postpartum (Tables 37, 38, 39, 40 and 41).

Pairwise comparison of the data of the stage revealed that both control and treatment I; and treatment I and treatment II were heterogeneous groups. Normal standard error difference test (table 42) showed significant difference in the values before oestrus and on the day of oestrus only in treatment I (P ∠ 0.01).

The haemoglobin levels of control, treatment I and treatment II are furnished in tables 43, 44 and 45 respectively. The percentage haemoglobin levels in the control animals at 2, 15, 30 and 45 days postpartum were 11.10 ± 00.40, 11.52 ± 00.62, 11.58 ± 00.54 and 11.20 ± 00.86 g per cent respectively. In the treatment I and treatment II, the corresponding levels were 11.84 ± 00.73, 12.42 ± 00.51, 12.15 ± 00.60, 13.00 ± 00.12 g per cent and 12.48 ± 00.53, 12.52 ± 00.57, 11.80 ± 00.61, 11.63 ± 00.40 g per cent respectively. On the day of oestrus the values were found to be 11.52 ± 00.61, 13.28 ± 00.12 and 12.78 ± 00.35 g per cent in the control, treatment I and treatment II respectively (Fig.8). There was no significant difference between the corresponding stages of the 3 groups except on the day of oestrum (P ∠ 0.05). Control and treatment I, and control and treatment II were found to be heterogeneous groups on pairwise comparison (Tables 46, 47, 48, 49 and 50). Analysis by normal standard error difference test (table 51) after regrouping of the data showed that there was significant difference in haemoglobin values prior to oestrum and on the day of oestrum in treatment I ($P < 0.01$).

TABLES

Table 1. Effect of body weight on postpartum oestrus. (control)

Sl. No.	Weight on 270th day of gestation (kg)	Postpartum weight 0 day (kg)	15th day (kg)	30th day (kg)	45th day (kg)	60th day (kg)	75th day (kg)	Weight on the day of onset of postpartum oestrus (kg)	No. of days for the onset of postpartum oestrus
1.	339	310	307	307	309	309	-	309	60
2.	440	404	394	394	394	395	395	395	64
3.	299	261	256	249	255	257		257	52
4.	360	336	318	319	326	329		329	52
5.	339	314	310	302	302	304		304	54
6.	255	235	226	226	226	226	226	226	63
7.	426	375	361	362	368	370	370	370	65
8.	355	328	324	316	320	325		325	59
9.	358	331	335	335	321	320	300	319	101
10.	386	359	340	335	336	337		337	51
Mean ± SE	355.70 ± 17.28	325.30 ± 15.85	317.30 ± 15.16	314.50 ± 15.55	315.70 ± 15.42	317.20 ± 15.50	322.75 ± 38.00	317.10 ± 15.50	62.10 ± 4.63

Table 2. Effect of body weight on postpartum oestrus
(Treatment I)

Sl. No.	Weight on 270th day of gestation (kg)	Postpartum weight 0 day (kg)	15th day (kg)	30th day (kg)	45th day (kg)	60th day (kg)	Weight on the day of onset of postpartum oestrus (kg)	No. of days for the onset of postpartum oestrus
1.	317	270	261	271	271	269	271	66
2.	316	287	285	294	294	295	295	65
3.	357	312	301	294	296	305	305	54
4.	389	349	360	366	366	378	378	56
5.	365	334	329	319	320	320	320	56
6.	381	343	334	334	354	350	357	79
7.	310	293	284	285	-	-	286	26
8.	310	282	280	283	284	286	286	76
9.	346	316	314	312	314	316	316	59
10.	280	247	248	248	-	-	248	29
Mean ± SE	335.10 ± 11.06	303.30 ± 10.51	299.60 ± 11.00	300.60 ± 10.62	312.38 ± 11.80	315.63 ± 12.77	306.20 ± 12.29	56.60 ± 5.53

Table 3. Effect of body weight on postpartum oestrus (Treatment II)

Sl. No.	Weight on 270th day of gestation (kg)	Postpartum weight 0 day (kg)	15th day (kg)	30th day (kg)	45th day (kg)	Weight on the day of postpartum oestrus (kg)	No. of days for the onset of postpartum oestrus
1.	409	367	370	375	379	378	53
2.	369	329	317	325	328	319	64
3.	293	257	256	257	257	257	35
4.	306	284	282	282	279	281	55
5.	431	385	380	392.5	393	397	60
6.	362	339	324	322	329	327	68
7.	329	306	307	307	307	307	57
8.	376	339	330	337	343	343	54
9.	431	395	394	395	399	399	33
Mean ± SE	367.33 ± 16.96	333.77 ± 16.72	329.55 ± 16.38	332.50 ± 16.13	333.77 ± 16.05	334.42 ± 16.00	53.22 ± 3.75

Table 4. Analysis of variance on body weight and postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	384.3168	192.1584	0.8583
Error	26	5820.8556	223.879	
Total	28	6205.1724		

Table 5. Analysis of variance of body weight on 0 day postpartum.

Source	df	SS	MSS	F
Treatment	2	4774.796	2387.398	1.2523
Error	26	49565.7557	1906.375	
Total	28	54340.55		

Table 6. Analysis of variance of body weight on 15 days postpartum.

Source	df	SS	MSS	F
Treatment	2	4331.2777	21653.6389	1.15098
Error	26	48920.7223	1881.566	
Total	28	53252		

Table 7. Analysis of variance of body weight on 30 days postpartum.

Source	df	SS	MSS	F
Treatment	2	5162.3863	2581.1932	1.3426
Error	26	49986.3723	1922.5528	
Total	28	55148.7586		

Table 8. Analysis of variance of body weight on 45 days postpartum.

Source	df	SS	MSS	F
Treatment	2	2650.3917	1325.1958	0.6613
Error	24	48095.275	2003.9698	
Total	26	50745.6667		

Table 9. Analysis of variance of body weight on the day of postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	3756.4961	1878.2480	0.8853
Error	26	55162.0556	2121.6175	
Total	28	58918.5517		

Table 10. Analysis of variance of number of days from calving to onset of oestrus.

Source	df	SS	MSS	F
Treatment	2	384.3168	192.1580	0.8583
Error	26	5820.8556	223.8791	
Total	28	6205.1724		

Table 11. Effect of body weight difference between days 16 and 30 postpartum on the onset of postpartum oestrus.

Sl. No.	Weight on the day of calving			Weight difference between days 16-30 postpartum			No. of days for the onset of postpartum oestrum			Co-efficient correlation.
	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	
1.	310	270	367	0	+10	+5	60	66	53	Control r1=0.2112
2.	404	287	329	0	+ 9	+8	64	65	64	Treatment I r2=0.1897
3.	261	312	357	-9	- 7	+1	52	54	35	Treatment II r3=0.4145
4.	336	349	284	+1	+ 6	0	52	56	55	r1 & r2 = 0.0406
5.	314	334	388	-8	-10	+6.5	54	56	60	r2 & r3 = 0.4070
6.	235	343	339	0	0	-2	63	79	68	r1 & r3 = 0.4238
7.	375	293	306	+1	+ 1	0	65	26	57	
8.	328	282	339	-8	+ 3	+7	59	76	54	
9.	331	316	395	0	- 2	+1	101	59	33	
10.	359	247		-5	0		51	29		
Mean	325.30±	303.30±	333.77±	-2.8	1	2.94	62.10±	56.60±	53.22±	
SE	15.65	10.51	16.72				4.63	5.53	3.75	

Table 12. Pattern of postpartum oestrum and ovulation.

Characteristics		Control	Treatment I	Treatment II
Duration of oestrus (hours)				
	10 - 15	1	-	-
	15 - 20	3	4	3
	20 - 25	4	4	5
	25 - 30	2	2	1
Intensity of heat				
	Pronounced	6	7	8
	Medium	3	3	1
	Weak	1	-	-
Time of ovulation after the end of oestrus (hours)				
	8 - 12	2	3	3
	12 - 16	5	4	4
	16 - 20	3	3	2

Table 13. Postpartum oestrous intervals and lactation yields of the herd, control, treatment I and treatment II cows.

Parameters	Performance of different groups			
	Herd (T1)	Control (T2)	Treatment I (T3)	Treatment II (T4)
Number of days for the onset of postpartum oestrus	82.50 ± 5.76 (71)	62.10 ± 4.63 (10)	56.60 ± 5.53 (10)	53.22 ± 3.75 (9)
Milk yield in one lactation (kg)	1765.50 ± 78.03 (71)	2435.50 ± 166.39 (10)	2264.80 ± 97.40 (10)	2241.00 ± 146.90 (9)

Figures in parenthesis denote number of observation.

Table 14. Analysis of variance on the postpartum oestrous interval (herd, control, treatment I and treatment II).

Source	df	SS	MSS	F
Treatment	3	0.2492	0.0831	6.079*
Error	96	1.5123	0.01367	
Total	99	1.5615		

T1 and T3 are heterogeneous
T1 and T4 are heterogeneous
T1 and T2 are homogeneous
T3 and T4 are ,,
T2 and T4 are ,,

Table 15. Analysis of variance on milk yield (herd, control, treatment I and treatment II)

Source	df	SS	MSS	F
Treatment	3	0.747813	0.249271	1.08556
Error	96	22.4845	0.234214	
Total	99	23.232315		

Table 16. Serum inorganic phosphorus levels (mg%) between calving and postpartum oestrum. Control.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post-partum oestrus
1.	4.30	4.30	4.30	5.00	5.00
2.	4.60	4.30	5.00	5.30	5.50
3.	4.60	4.30	4.90	5.30	5.30
4.	4.60	4.60	4.90	4.90	4.90
5.	5.20	4.90	4.90	4.90	5.20
Mean ± SE	4.66 ± 00.15	4.88 ± 00.12	4.80 ± 00.13	5.08 ± 00.09	5.18 ± 00.11

Table 17. Serum inorganic phosphorus levels (mg%) between calving and postpartum oestrum. Treatment I

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of onset of postpartum oestrus
1.	4.30	4.30	4.10	4.60	4.60
2.	4.53	4.30	4.30	4.30	4.30
3.	4.00	4.00	4.90	4.60	4.80
4.	4.00	5.00			8.00
5.	4.30	4.30	5.40	4.90	5.30
Mean ± SE	4.42 ± 00.28	4.38 ± 00.17	4.68 ± 00.30	4.60 ± 00.12	5.44 ± 00.71

Table 18. Serum inorganic phosphorus levels (mg%) between calving and postpartum oestrum. Treatment II.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of onset of postpartum oestrus
1.	4.30	5.00	4.00		5.20
2.	4.60	4.70	3.90	4.90	4.90
3.	4.50	4.10	4.60	4.60	4.90
4.	5.00	4.70	5.00	5.30	5.30
5.	4.70	4.70	4.70	4.70	4.70
Mean	4.62	4.64	4.44	4.88	5.00
SE	00.12	00.15	00.21	00.15	00.11

Table 19. Analysis of variance of level of serum inorganic phosphorus between three groups at 2 days postpartum.

Source	df	SS	MSS	F
Treatment	2	0.156651	0.078325	0.406268
Error	12	2.313522	0.192794	
Total	14	2.47017		

Table 20. Analysis of variance of level of serum inorganic phosphorus between three groups at 15 days postpartum.

Source	df	SS	MSS	F
Treatment	2	0.172	0.086	0.813878
Error	12	1.268	0.105667	
Total	14	1.44		

Table 21. Analysis of variance of level of serum inorganic phosphorus between three groups at 30 days postpartum.

Source	df	SS	MSS	F
Treatment	2	0.332643	0.166322	0.809711
Error	1	2.25947	0.205409	
Total	3			

Table 22. Analysis of variance of level of serum inorganic phosphorus between three groups at 45 days postpartum.

Source	df	SS	MSS	F
Treatment	2	0.512192	0.256096	4.02788
Error	10	0.635808	0.063581	
Total	12	1.148		

Table 23. Analysis of variance of level of serum inorganic phosphorus between three groups on the day of postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	0.489333	0.244667	
Error	12	10.52	0.876667	0.279088
Total	14	11.009333		

Table 24. Normal standard error difference test. Levels of serum inorganic phosphorus (mg%).

Items	Levels postpartum prior to the onset of oestrus			Levels on the day of postpartum oestrus.			Values	Difference in mean / SE of mean	
	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II
Mean	4.81	4.51	4.65	5.18	5.44	5			
Standard deviation	0.31	0.46	0.35	0.24	1.59	0.24	2.84**	1.29	2.59**
No. of observations	24	18	20	5	5	5			

Table 25. Serum protein (g%) levels between calving and postpartum oestrus. Control.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post-partum oestrus
1.	8.45	8.25	9.15	9.15	9.50
2.	7.65	7.65	8.00	8.40	9.50
3.	9.15	8.45	8.40	9.15	9.50
4.	8.00	8.45	8.45	8.90	9.15
5.	8.60	8.00	8.45	8.25	8.45
Mean	8.37 ± 00.26	8.16 ± 00.15	8.19 ± 00.19	8.77 ± 00.19	9.22 ± 00.20

Table 26. Serum protein (g%) levels between calving and postpartum oestrus. Treatment I.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post-partum oestrus
1.	7.80	7.80	7.80	8.25	8.00
2.	7.10	7.10	8.00	8.00	8.25
3.	8.00	7.80	8.45	8.00	8.45
4.	7.65	8.45	..	..	8.25
5.	8.45	8.00	8.25	8.60	8.45
Mean ± SE	7.80 ± 00.22	7.83 ± 00.22	8.13 ± 00.14	8.21 ± 00.14	8.2[illegible] ± 00.08

Table 27. Serum protein (g%) levels between calving and postpartum oestrus. Treatment II.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post-partum oestrus
1.	8.90	8.95	8.60	..	9.35
2.	8.70	9.15	8.95	9.15	9.15
3.	9.15	8.95	9.90	9.35	9.35
4.	9.70	9.15	9.35	9.35	9.15
5.	7.80	8.25	9.15	8.00	8.45
Mean ± SE	9.05 ± 00.35	8.89 ± 00.17	9.19 ± 00.22	8.96 ± 00.32	9.09 ± 00.17

Table 28. Analysis of variance of level of serum protein between three groups at 2 days postpartum.

Source	df	SS	MSS	F
Treatment	2	3.916333	1.958167	4.95948*
Error	12	4.738	0.394833	
Total	14	8.654333		

Treatment I and Treatment II Heterogeneous.
Control and Treatment I Homogeneous
Control and Treatment II ,,

Table 29. Analysis of variance of level of serum protein between three groups at 15 days postpartum.

Source	df	SS	MSS	F
Treatment	2	2.942333	1.471167	0.92456
Error	12	19.094503	1.591209	
Total	14	22.036833		

Table 30. Analysis of variance of level of serum protein between three groups at 30 days postpartum.

Source	df	SS	MSS	F
Treatment	2	2.685643	1.3428	
Error	11	1.866495	0.16968	7.91367 *
Total	13	4.552143		

Control and Treatment I heterogeneous
Treatment I and Treatment II ,,
Control and Treatment II homogeneous

Table 31. Analysis of variance of level of serum protein between three groups at 45 days postpartum.

Source	df	SS	MSS	F
Treatment	2	1.22748	0.61374	2.76899
Error	10	2.21648	0.221648	
Total	12	3.44396		

Table 32. Analysis of variance of level of serum protein between three groups on the day of postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	2.594333	1.29717	10.2206*
Error	12	1.523000	0.126917	
Total	14	4.117333		

Control and Treatment I	heterogeneous
Treatment I & Treatment II	,,
Control and Treatment II	homogeneous

Table 33. Normal standard error difference test. Levels of serum protein (g%).

Item	Levels postpartum prior to oestrus			Levels on the day of postpartum oestrus			Values	Difference in mean / SE of mean	
	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II
Mean	8.48	9.97	9.03	9.22	8.28	9.09	..	..	..
Standard deviation	0.48	0.42	0.54	0.46	0.19	0.37	3.24**	2.38*	0.293
No. of observations	25	18	20	5	5	5			

Table 34. Serum glucose level (mg%) between calving and postpartum oestrus. Control.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post partum oestrus
1.	55.50	50.00	50.00	54.00	54.00
2.	50.00	45.80	50.00	46.40	50.00
3.	42.80	46.40	58.30	54.10	58.30
4.	64.20	58.30	54.10	57.10	57.10
5.	75.00	66.60	62.50	53.50	66.60
Mean ± SE	57.40 ± 5.60	53.42 ± 3.98	54.98 ± 2.43	53.02 ± 1.77	57.20 ± 2.75

Table 35. Serum glucose level (mg%) between calving and postpartum oestrus. Treatment I.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of post-partum oestrus
1.	52.70	50.00	50.00	58.30	64.20
2.	57.14	33.30	33.30	40.40	50.00
3.	41.60	50.00	21.40	54.10	62.50
4.	58.30	62.50	..	..	..
5.	67.80	57.10	41.50	53.50	71.40
Mean ± SE	55.51 ± 4.26	50.58 ± 4.92	36.55 ± 6.09	53.08 ± 2.47	61.04 ± 3.50

Table 36. Serum glucose level (mg%) between calving and postpartum oestrus. Treatment II.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of postpartum oestrus.
1.	50.10	50.00	53.80	..	53.50
2.	58.30	54.10	50.00	53.50	58.30
3.	64.20	57.10	58.30	62.50	64.20
4.	71.40	58.30	54.10	57.10	64.50
5.	71.40	66.60	58.30	58.30	64.20
Mean ± SE	63.08 ± 4.07	57.22 ± 2.75	54.90 ± 1.50	57.65 ± 1.80	60.94 ± 2.19

Table 37. Analysis of variance of levels of serum glucose between three groups at 2 days postpartum.

Source	df	SS	MSS	F
Treatment	2	155.295413	77.6477	0.70398
Error	12	1323.57728	110.298	
Total	14	1478.872693		

Table 38. Analysis of variance of levels of serum glucose between three groups at 15 days postpartum.

Source	df	SS	MSS	F
Treatment	2	110.992	55.496	0.319101
Error	12	2086.962	173.9135	
Total	14	2197.954		

Table 39. Analysis of variance of levels of serum glucose between three groups at 30 days postpartum.

Source	df	SS	MSS	F
Treatment	2	951.669143	475.83457	8.348*
Error	11	627.028	57.002545	
Total	13	1578.69143		

Control and Treatment I Heterogeneous
Treatment I and TreatmentII ,,
Control and Treatment II Homogeneous

Table 40. Analysis of variance of levels of serum glucose between three groups at 45 days postpartum.

Source	df	SS	MSS	F
Treatment	2	63.9576	31.9788	1.984855
Error	11	177.2255	16.111407	
Total	13	241.183077		

Table 41. Analysis of variance of levels of serum glucose between three groups on the day of postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	47.905333	23.952667	0.569438
Error	12	504.764	42.063667	
Total	14	552.669333		

Table 42. Normal standard error difference test. Levels of serum glucose.

Items	Levels postpartum prior to oestrus			Levels on the day of oestrus			Values	Difference in mean / SE of mean	
	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II
Mean	54.95	49.39	58.29	57.2	61.04	60.94	..	..	..
Standard deviation	7.46	11.56	6.29	6.16	8.01	4.9	0.715	2.59*	1.018
No. of observations	24	18	20	5	5	5			

Table 43. Haemoglobin (g%) level between calving and postpartum oestrus. Control.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of postpartum oestrus.
1.	10.29	11.60	12.00	12.20	11.00
2.	12.10	12.30	12.00	12.20	10.90
3.	11.80	11.50	12.00	12.00	12.30
4.	10.10	10.60	10.90	10.70	11.40
5.	11.20	11.40	11.00	10.90	12.00
Mean ± SE	11.10 ± 00.40	11.52 ± 00.62	11.58 ± 00.54	11.20 ± 00.86	11.52 ± 00.61

Table 44. Haemoglobin (g%) level between calving and postpartum oestrus. Treatment I.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of postpartum oestrus
1.	12.60	12.80	13.00	13.40	13.00
2.	12.00	12.60	12.40	13.00	13.00
3.	12.60	12.60	12.80	13.60	13.60
4.	13.00	13.60	..	..	13.40
5.	9.00	10.50	10.50	12.00	13.40
Mean ± SE	11.84 ± 00.73	12.42 ± 00.51	12.15 ± 00.60	13.00 ± 00.12	13.28 ± 00.12

Table 45. Haemoglobin (g%) level between calving and postpartum oestrus. Treatment II.

Sl. No.	2nd day after calving	15th day after calving	30th day after calving	45th day after calving	On the day of postpartum oestrus
1.	12.50	13.10	13.00	..	13.60
2.	12.60	11.00	9.50	12.20	13.60
3.	13.20	13.40	12.10	11.60	12.60
4.	13.60	13.80	12.60	10.50	12.00
5.	10.50	11.30	11.80	12.20	12.10
Mean	12.48±	12.52 ±	11.80 ±	11.63 ±	12.78 ±
SE	00.53	00.57	00.61	00.40	00.35

Table 46. Analysis of variance of levels of haemoglobin between three groups at 2 days postpartum.

Source	df	SS	MSS	F
Treatment	2	4.78348	2.39174	1.475163
Error	12	19.45608	1.62134	
Total	14	24.23956		

Table 47. Analysis of variance of levels of haemoglobin between three groups at 15 days postpartum.

Source	df	SS	MSS	F
Treatment	2	3.03333	1.516667	1.359822
Error	12	13.384	1.115334	
Total	14	16.41733		

Table 48. Analysis of variance of levels of haemoglobin between three groups at 30 days postpartum.

Source	df	SS	MSS	F
Treatment	2	0.793071	0.395737	0.346709
Error	11	12.555499	1.141409	
Total	13	13.34857		

Table 49. Analysis of variance of levels of haemoglobin between three groups at 45 days postpartum.

Source	df	SS	MSS	F
Treatment	2	7.868192	3.934096	
Error	10	10.8995	1.08995	3.609428
Total	12	18.767692		

Table 50. Analysis of variance of levels of haemoglobin between three groups on the day of postpartum oestrus.

Source	df	SS	MSS	F
Treatment	2	8.225333	4.112667	11.623642*
Error	12	4.244	0.353667	
Total	14	12.449333		

Control and Treatment I Heterogeneous
Control and Treatment II -do-
Treatment I and Treatment II Homogeneous.

Table 51. Normal standard error difference test. Levels of haemoglobin.

Item	Levels postpartum prior to oestrum			Levels on the day of oestrum			Value $\frac{\text{Difference in mean}}{\text{SE of mean}}$		
	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II	Control	Treatment I	Treatment II
Mean	11.32	12.38	12.20	11.52	13.28	12.78	..	..	..
Standard deviation	0.74	1.15	1.17	0.61	0.27	0.78	0.657	3.09**	1.914
No. of observations	24	19	20	5	5	5			

ILLUSTRATIONS

Fig. 1. Postpartum body weight pattern (control)

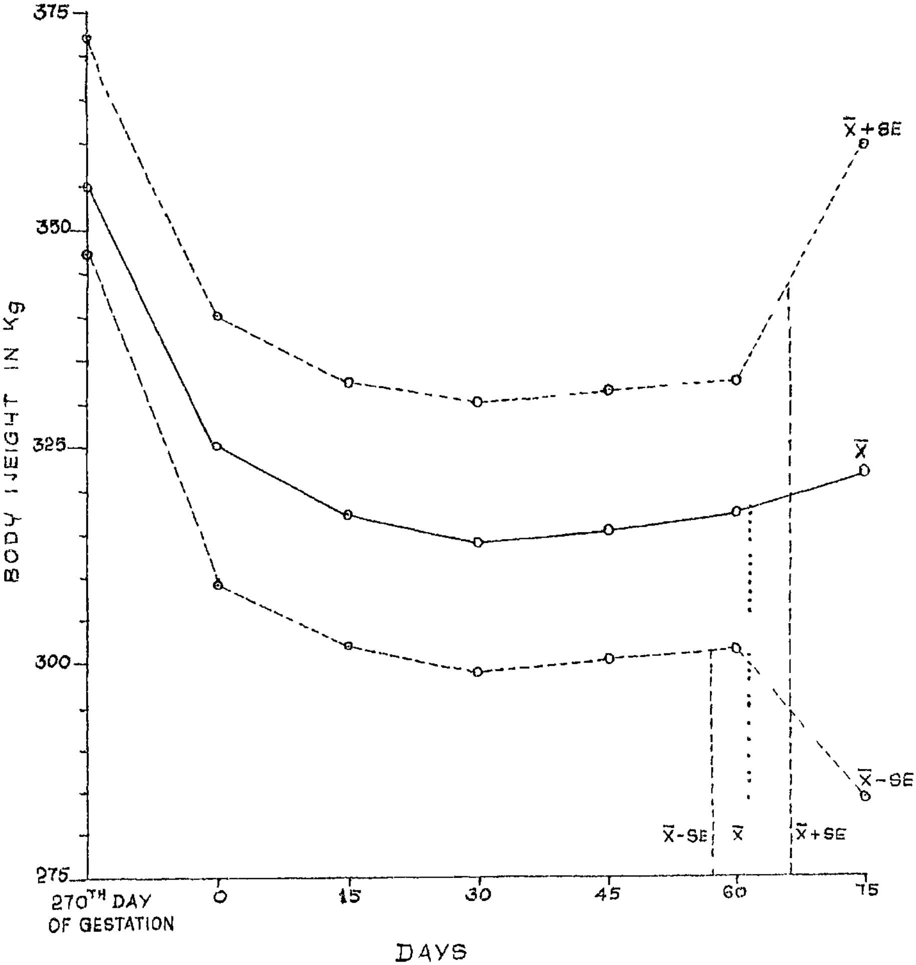


Fig. 2. Postpartum body weight pattern (Treatment - I)

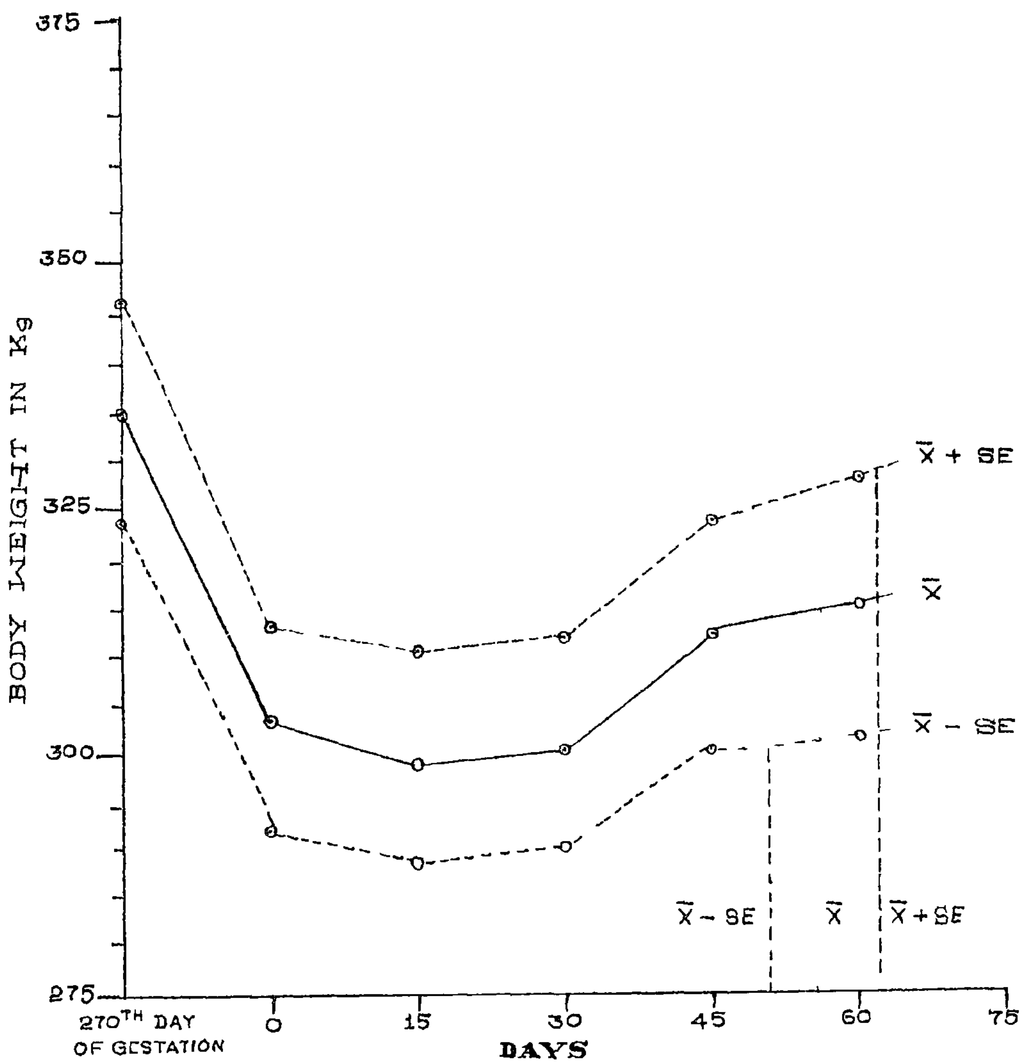


Fig. 3. Postpartum body weight pattern (Treatment -II)

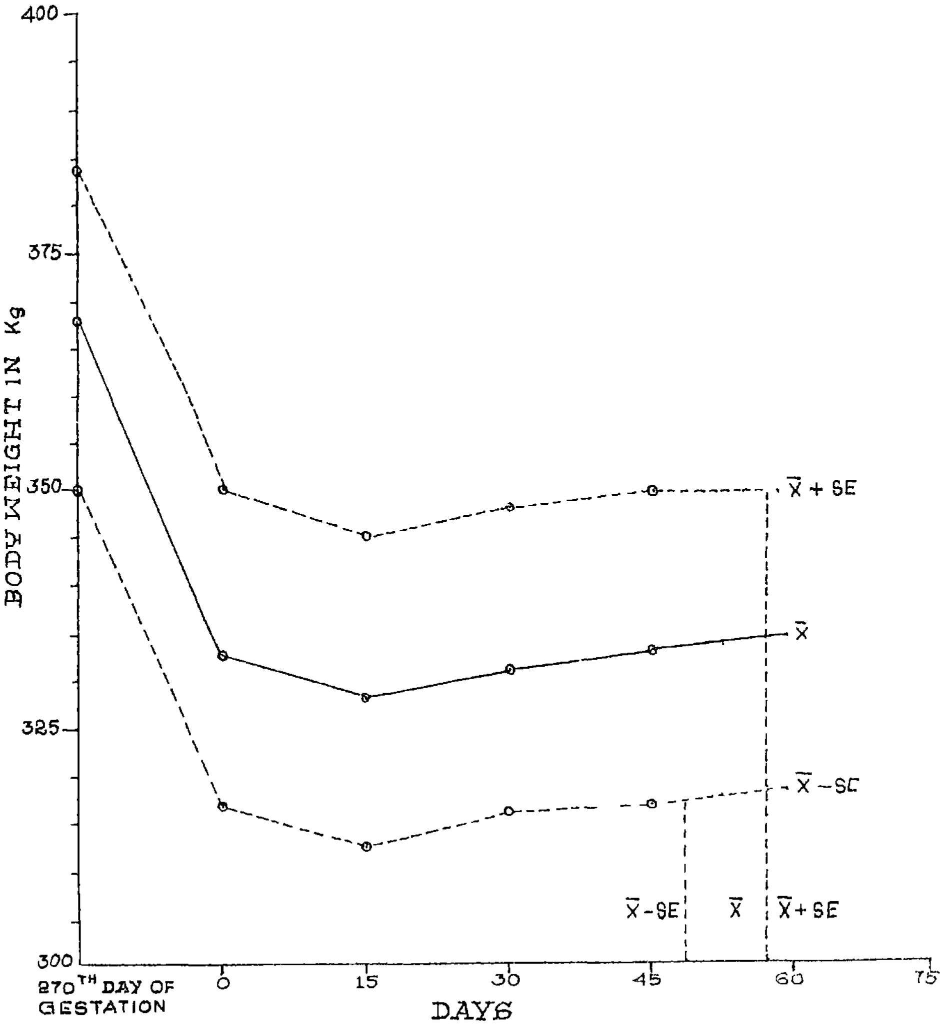


Fig. 4. **Postpartum oestrous interval**

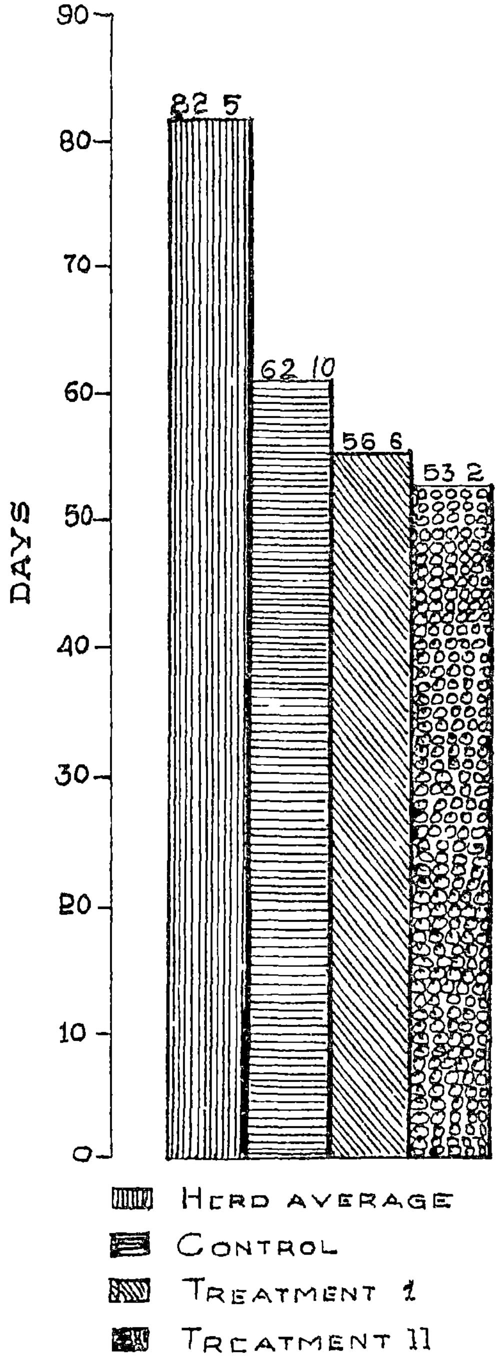


Fig.5. Serum inorganic phosphorus (mg %)

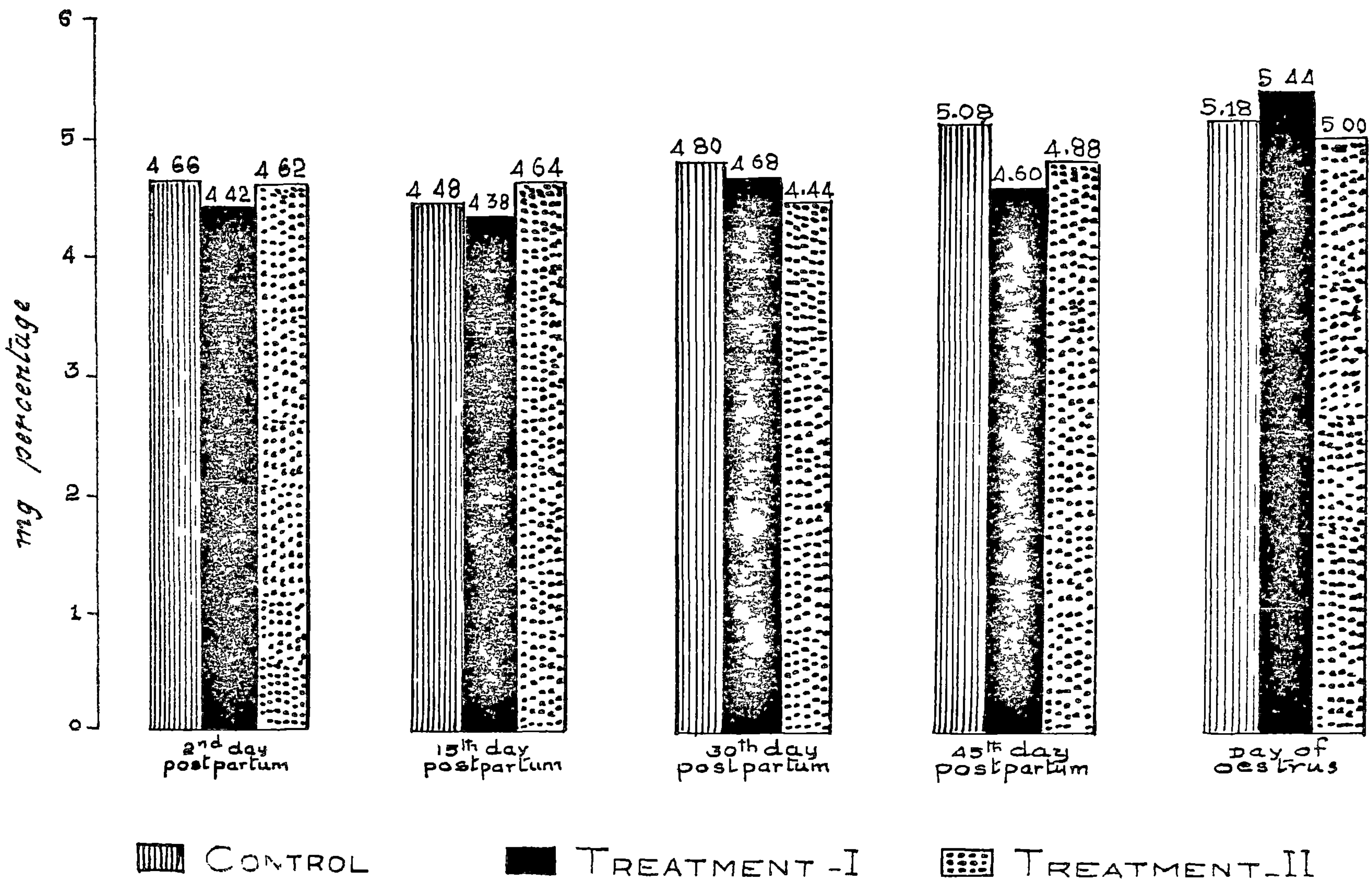


Fig.6. Serum protein level (G %)

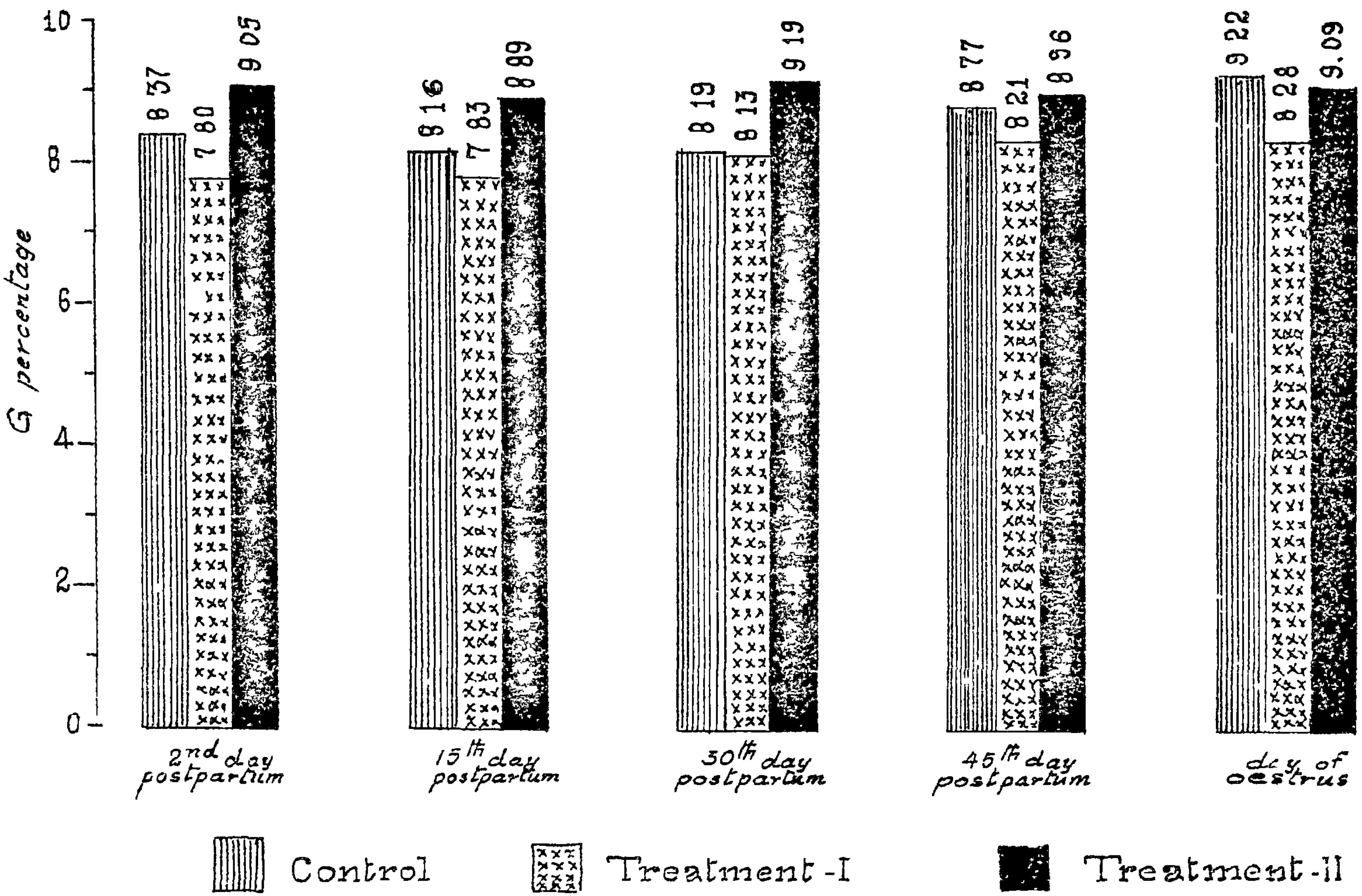


Fig.7. Serum glucose level (mg %)

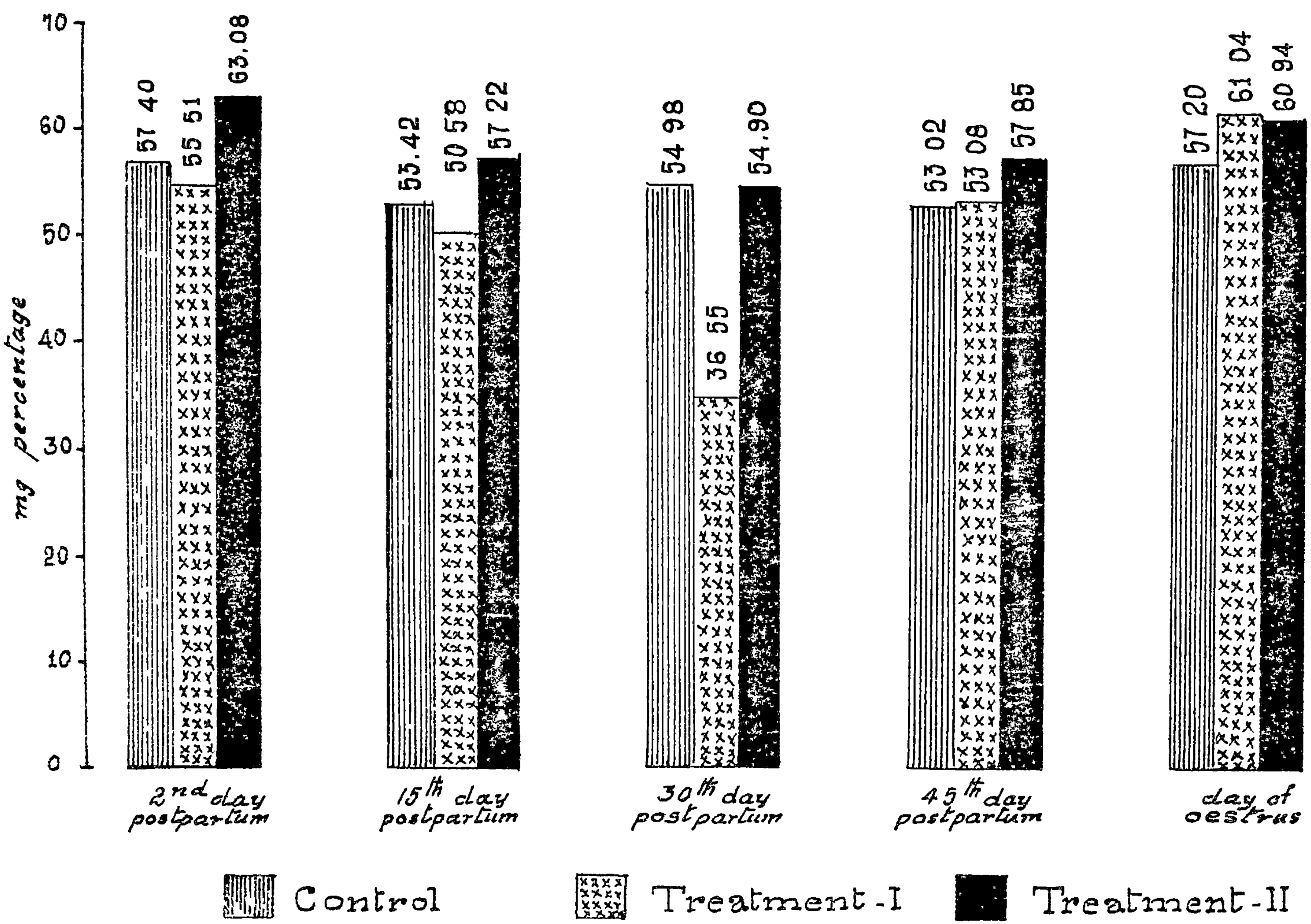
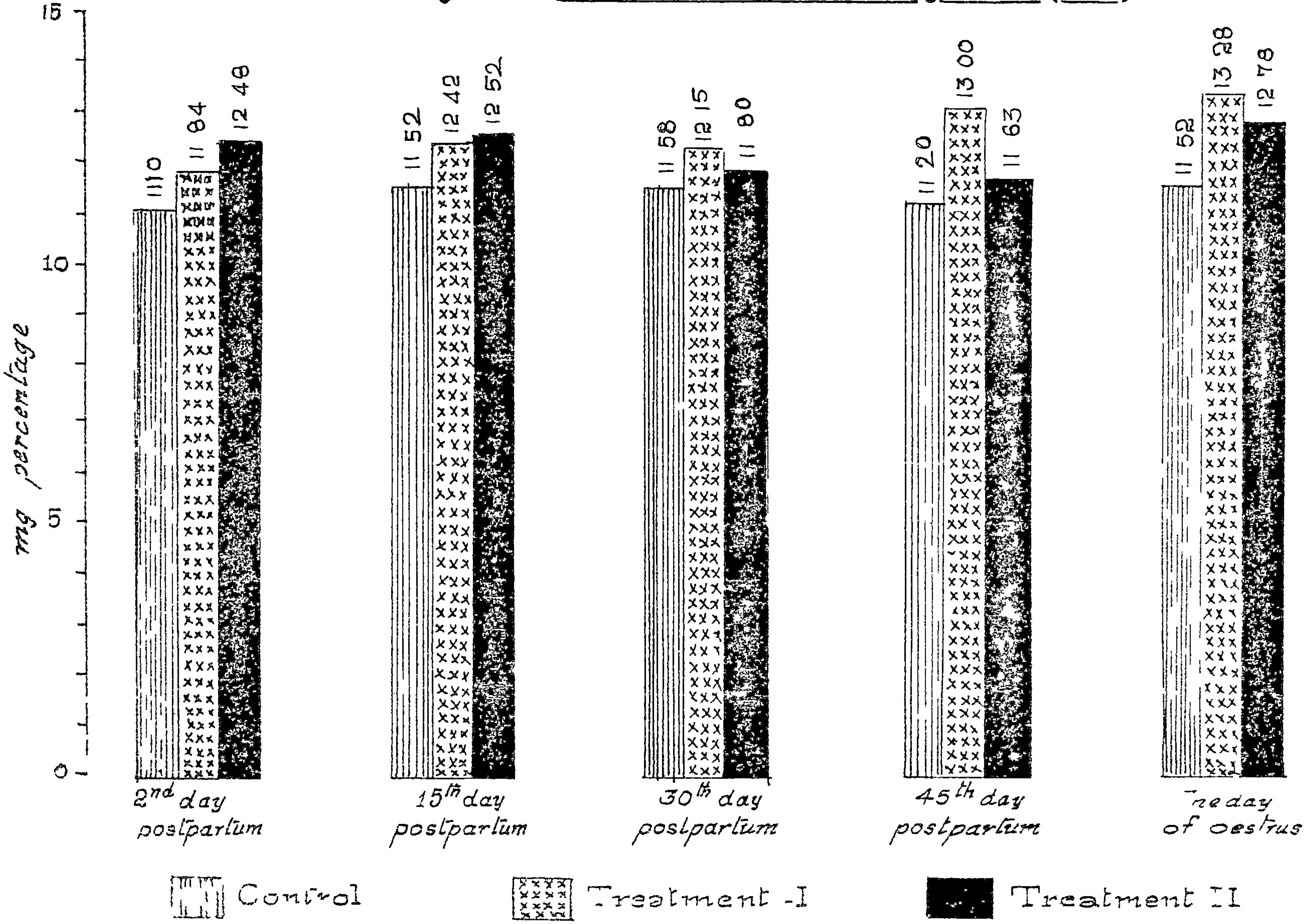


Fig. 8. Level of haemoglobin (mg%)



DISCUSSION

DISCUSSION

Prolonged intercalving period due to reproductive inefficiency is a very serious deterrent to economic cattle rearing. Reproductive performance of cattle is greatly influenced by a variety of factors of which nutrition is the most important. This is more so in a freshly calved high yielding cow which is subjected to lactational stress and hence prone to negative energy and negative nitrogen balance. It is established that there is positive correlation between postpartum gain in body weight and fertility in dairy cows. The cows which gain body weight early during postpartum period exhibit oestrus and conceive earlier. Cows maintained under low plane of nutrition do not attain the target weight essential for efficient reproductive performance. This study was designed to throw light on the effect of higher plane of nutrition in increasing the postpartum reproductive efficiency in cross-bred cows.

From the data furnished in tables 1, 2 and 3 it could be seen that there was an abrupt fall in the body weight of cows consequent to calving. The weight loss after calving was 30.40, 31.8 and 33.57 kg in control, treatment I and treatment II respectively. Patil (1976) recorded a weight loss of 26.63 kg in Gir cows on calving which is lower than the present observation. This difference could be attributed to higher birth weight of cross-bred calves. The decline in body weight continued in the first fortnight in all the three groups, though at a reduced rate. This decreasing trend in body weight further continued upto 30 days post-partum in control, but in both treatment groups body weight registered a slight increase during 16 to 30 days postpartum. Further thistrend was maintained until the onset of post-partum oestrum which occurred earlier in the treatment groups than in the control animals. Bond and Weiland(1978) also reported a similar trend on body weight and onset of postpartum oestrus in cows. They found early onset of postpartum oestrum when dietary levels were increased immediately after calving in Aberdine Angus cows. In the control animals, the body weight almost levelled between 30 and 60 days postpartum and showed a steep upward trend only at 75 days. It was also found that the animals in all the three groups exhibited oestrus while gaining body weight but the animals of the treatment groups which evinced higher rate of weight gain showed oestrum earlier. This is in accordance with the findings of McClure (1965), Baker (1969), and Patil and Deshpande (1979, 1981). The intervals from calving to oestrus were 62.10 $\pm$ 4.63, 56.60 $\pm$ 5.53 and 53.22 $\pm$ 5.75 days in control, treatment I and treatment II respectively. Though there was no significant difference in the postpartum oestrous interval between groups, it was apparent that the animals in the treatment II and treatment I which received higher plane of nutrition during postpartum period came to oestrum earlier than the control animals (Table 1 to 11). This essentially is in keeping with the findings of Bond and Weiland (1978). However, statistical analysis did not reveal any positive correlation between body weight and postpartum oestrus in all the three groups. This may be attributed to the fact that animals in all the three groups showed good gain in body weight and short postpartum oestrous interval since they were maintained on adequate dietary levels. Positive correlation between body weight and postpartum oestrous interval has been reported by many workers (McClure, 1965; King, 1968; Youdan and King, 1977; Patil and Deshpande, 1979; Bhaskaran et al. 1982). This was done by comparing the data on reproductive performance of postpartum cows which gained body weight with those which lost body weight in spite of identical feeding and management. The absence of positive correlation in the present study could be attributed to the variation in the design of the experiment and the analysis of the data.

The fact that there was no significant difference in postpartum oestrous interval between the three groups, clearly points out that the ration prescribed by Sen and Ray standard is quite adequate not only to meet the production requirement but also to cover the need for efficient reproductive functions of the dairy cow.

The grouped data on duration of oestrus, intensity of oestrum and time of ovulation are furnished in table 12. Analysis of the data revealed no significant variation between groups.

The data on postpartum oestrous interval of the herd were compared with those of the control and treatment groups (Tables 13 and 14). The postpartum oestrous interval of the herd (82.50 ± 5.76 days) was significantly higher than those of treatment I and II, even though it was found to be homogeneous with that of the control. This difference could be possibly attributed to better management of experimental animals.

The association between variation in blood composition and disease has long been recognised. The importance of analysis of blood constituents in assessing the adequacy of dietary intake for production is emphasised by Pyne <u>et al.</u> (1970), who designed a "metabolic profile test". The relationship of serum inorganic phosphorus, protein, glucose and haemoglobin with fertility of the animal has been reported by various workers (Hignett and Hignett, 1951; Boyd, 1970; King, 1971; Morrow, 1977; Samad et al., 1980).

The data on serum inorganic phosphorus levels of control, treatment I and treatment II are furnished in tables 16, 17 and 18 respectively. The serum inorganic phosphorus levels in control animals at 2, 15, 30 and 45 days postpartum were 4.66 ± 00.15, 4.48 ± 00.12, 4.80 ± 00.13 and 5.08 ± 00.09 mg per cent respectively. The corresponding levels in treatment I and treatment II were respectively 4.42 ± 00.28, 4.38 ± 00.17, 4.68 ± 00.30, 4.60 ± 00.12 mg per cent and 4.62 ± 00.12, 4.64 ± 00.15, 4.44 ± 00.21, 4.88 ± 00.15 mg per cent. The serum inorganic phosphorus levels on the day of oestrum were 5.18 ± 00.11, 5.44 ± 00.71 and 5.00 ± 00.11 mg per cent in the control, treatment I and treatment II respectively. Statistical analysis of data did not reveal any significant difference between the corresponding stages of three groups (tables 19 to 23). Analysis of the regrouped data (table 24) showed that the levels of serum inorganic phosphorus on the day of oestrum in both control and treatment II were significantly higher than those before oestrum. Pillai (1980) reported the serum inorganic phosphorus level of postpartum anoestrous cows to be 4.05 mg per cent. This wide variation in the serum phosphorus values between normal cycling animals and anoestrous cows could possibly be exploited for confirmation of anoestrum due to phosphorus deficiency.

The data on serum protein levels are presented in tables 25 - 27. The serum protein levels in control animals at 2, 15, 30 and 45 days postpartum were 8.37 ± 00.26, 8.16 ± 00.15, 8.19 ± 00.19 and 8.77 ± 00.19 g per cent respectively. The corresponding levels in respect of treatment I and II were respectively 7.80 ± 00.22, 7.83 ± 00.22, 8.13 ± 00.14, 8.21 ± 00.14 g per cent; and 9.05 ± 00.35, 8.89 ± 00.17, 9.19 ± 00.22, 8.96 ± 00.32 g per cent. The serum protein levels on the day of oestrus were 9.22 ±00.20, 8.28 ± 00.08 and 9.09 ± 00.17 g per cent in the control, treatment I and treatment II respectively. Statistical analysis has shown significant difference in the values on days 2, 30 and on the day of oestrus. Application of normal standard error difference test revealed significant difference in the values prior to oestrum and on the day of oestrum in both control and treatment I (table 35). The values presently obtained are slightly higher than the values reported by Deshpande <u>et al</u>. (1978) and Blood <u>et al</u>. (1979). The serum protein levels on the day of oestrum in all the three groups are much higher than the levels reported for anaestrous cows by Patil, 1976

(6.71 g per cent) and Pillai, 1979(6.83 g per cent). The serum protein level is an index of nutritional status and hence higher serum protein levels obtained in all the experimental animals reflect their higher nutritional status.

The serum glucose levels in control, treatment I and treatment II are presented in tables 34 to 36. The level of serum glucose in control animals at 2, 15, 30 and 45 days postpartum were 57.40 ± 5.60, 53.42 ± 3.98, 54.98 ± 2.43 and 53.02 ± 1.77 mg per cent respectively. The corresponding levels for the treatment I and treatment II were respectively 55.31 ± 4.26, 50.58 ± 4.92, 36.55 ± 6.09, 53.08 ± 2.47 mg per cent; and 63.08 ± 4.07, 57.22 ± 2.75, 54.90 ± 1.50, 57.85 ± 1.86 mg per cent. The serum glucose levels on the day of oestrus were 57.20 ± 2.75, 61.04 ± 3.58 and 60.94 ± 2.19 mg per cent in the control, treatment I and treatment II respectively. Statistical analysis of the data by one way classification revealed no significant difference between corresponding stages of the 3 groups, except at 30 days postpartum (tables 37 to 41). Pairwise comparison of the data in the above stage revealed that both control and treatment I; and treatment I and treatment II were heterogeneous groups. Normal standard error difference test(Table 42) showed significant difference in the values before oestrus and on the day of oestrus in treatment I only.

The values presently obtained are in agreement with the reported values for normal cycling cows (Gonzaga and Vergara, 1956; Harrock and Patterson, 1957; Dukes, 1970). An extremely low serum glucose value in the range 39.40 to 44.38 mg per cent has been reported in anoestrous cows (Sane, 1972; Patil, 1976). The low serum glucose level in anoestrous cow is a pointer to the negative energy balance of the cow due to poor nutritional status. The higher glucose values presently obtained in all the 3 groups reflect the higher nutritional status of the experimental animals.

The haemoglobin levels in control, treatment I and treatment II are furnished in tables 43, 44 and 45 respectively. The percentage of haemoglobin in the control animals at 2, 15, 30 and 45 days postpartum were 11.10 ± 00.40, 11.52 ± 00.62, 11.58 ± 00.54 and 11.20 ± 00.86 g per cent respectively. In the treatment I and treatment II, the corresponding values were respectively 11.84 ± 00.73, 12.42 ± 00.51, 12.15 ± 00.60, 13.00 ± 00.12 g per cent; and 12.48 ± 00.53, 12.52 ± 00.57, 11.80 ± 00.61, 11.63 ± 00.40 g per cent. On the day of oestrum the haemoglobin levels were recorded to be 11.52 ± 00.61, 13.28 ± 00.12, and 12.78 ± 00.35 g per cent in the control, treatment I and treatment II respectively. There was no significant difference in haemoglobin levels between the corresponding stages of the three groups except on the day of oestrus. Control and treatment I; and control and treatment II were found to be heterogeneous groups on pairwise comparison. Analysis by normal standard error difference test (table 51) after regrouping the data showed that there was significant difference in haemoglobin levels prior to oestrus and on the day of oestrus in treatment I only. The values presently obtained are comparable with those recorded by Mishra and Biswal (1961), Mithuji <u>et al</u>. (1962), Rattan <u>et al</u>. (1966) and Patil (1976). An extremely low percentage of haemoglobin in the range of 8.00 to 9.80 g per cent has been reported in anoestrous cows (Morrow, 1970; Wagner, 1972; Pillai, 1980). This low value in anoestrous cows is a pointer to the poor nutritional status of the cow. The higher values presently obtained herald the high nutritional and reproductive status of the experimental animals.

Even though there was significant difference in certain blood parameters at some stages and between certain groups, no definite pattern for serum levels of phosphorus, protein and glucose and percentage haemoglobin emerged in the 3 groups during the present study. This has made it impractical to correlate these important parameters with the postpartum reproductive status of the animals. Moreover, the fact that the blood levels of these constituents were well within the physiological range of normal cycling animals in all the three groups made such a comparison to be of little practical relevance.

SUMMARY

SUMMARY

The aim of the present investigation was to assess the effect of higher dietary levels on the postpartum reproductive performance of cross-bred cows.

Thirty cross-bred cows of the University Livestock Farm in advanced stage of gestation but before completion of 270 days formed the materials for the study. These animals were weighed on the 270th day of gestation and on the day of calving to obtain the prepartum and postpartum body weight. After calving, these cows were randomly allotted to three groups of 10 animals each. The first group was treated as control and was given the farm ration based on Sen and Ray standard. The animals in the 2nd and 3rd groups were given respectively 115 and 130 per cent farm ration. While roughage was fed in the above proportion, water was provided <u>ad libitum</u>. All the animals were weighed at 15 days intervals from the day of calving until the first postpartum oestrum. The pattern of postpartum oestrus such as duration and intensity of oestrum and time of ovulation was also studied. Data on postpartum oestrum and lactational yield of 71 cows from the farm herd were collected and compared with those of the experimental groups.

Blood samples of five animals from each experimental group were collected on days, 2, 15, 30 and 45 postpartum and also on the day of oestrus. The serum inorganic phosphorus,

protein, glucose and percentage haemoglobin were estimated.

The weight of animals in the control and treatment groups I and II averaged 355.70 ± 17.28, 335.10 ± 11.06 and 367.33 ± 16.96 kg respectively at 270 days gestation. The mean postpartum body weight on '0' day of calving were 325.30 ± 15.85, 303.30 ± 10.51 and 333.77 ± 16.72 kg respectively indicating a steep decline. The postpartum body weight at days 15, 30, 45 and on the day of oestrum in control were 317.30 ± 15.16, 314.50 ± 15.55, 315.70 ± 15.42 and 317.10 ± 15.50 kg respectively. The corresponding body weight in treatment I were 299.60 ± 11.00, 300.60 ± 10.62, 312.38 ± 11.80 and 306.2 ± 12.29 kg; and in treatment II were 329.55 ± 16.38, 332.50 ± 16.13, 333.77 ± 16.05 and 334.42 ± 16.00 kg. The decline in body weight continued through the first fortnight in all the three groups. However, the decreasing trend in body weight was maintained upto 30 days postpartum in the control animals. The animals in both treatment groups showed a slightly increasing trend in body weight from 15 days postpartum onwards and this became more pronounced between 30 and 45 days after calving. The body weight of animals in the control group almost levelled between 30 and 60 days postpartum and showed a steep upward trend only at 75 days. The mean postpartum oestrous interval of the animals in control, treatment I and treatment II were 62.10 ± 4.63, 56.60 ± 5.53 and 53.22 ± 3.75 days respectively. Though the postpartum body weight did not have any significant influence on the onset of first postpartum oestrus in all the three groups, the treatment groups which showed weight gain beyond 15 days postpartum came to oestrum much earlier than the control. Statistical analysis of the data on body weight of the corresponding stages in the three groups also did not show any significant variation. Though the body weight changes in different groups were apparently manifest between 16 and 30 days postpartum, there was no statistical significance.

Analysis of the grouped data on duration and intensity of oestrus, and time of ovulation revealed no significant variation between groups.

The postpartum oestrous interval of herd was 82.50 ± 5.76 days as against 62.10 ± 4.63, 56.60 ± 5.53 and 53.22 ± 3.50 days of the control, treatment I and treatment II respectively. Statistical analysis revealed that there was significant difference between groups on the onset of postpartum oestrum.

The serum inorganic phosphorus levels at 2, 15, 30 and 45 days postpartum were 4.66 ± 00.15, 4.48 ± 00.12, 4.80 ± 00.13 and 5.08 ± 00.09 mg per cent respectively in the control; 4.42 ± 00.28, 4.38 ± 00.17, 4.68 ± 00.30 and 4.60 ± 00.12 mg per cent respectively in treatment I and 4.62 ± 00.12, 4.64 ± 00.15, 4.44 ± 00.21 and 4.88 ± 00.15 mg per cent respectively in treatment II. The levels on the day of oestrum were 5.18 ± 0.11, 5.44 ± 00.71 and 5.00 ± 00.11 mg per cent in the control, treatment I and treatment II respectively. Statistical analysis of the data did not reveal any significant difference in serum inorganic phosphorus levels between the corresponding stages of the three groups. However, significant difference could be noticed between the values before oestrus and on the day of oestrus in control and treatment II.

The levels of serum protein at 2, 15, 30 and 45 days postpartum were 8.37 ± 00.26, 8.16 ± 00.15, 8.19 ± 00.19 and 8.77 ± 00.19 g per cent respectively in control, 7.8 ± 00.22, 7.83 ± 00.22, 8.13 ± 00.14 and 8.21 ± 00.14 g per cent respectively in treatment I and 9.05 ± 0.35, 8.89 ± 00.17, 9.19 ± 00.22 and 8.96 ± 00.32 g per cent respectively in treatment II. The levels on the day of oestrum were 9.22 ± 00.20, 8.28 ± 00.08 and 9.09 ± 0.17 g per cent in the control, treatment I and treatment II respectively. Statistical analysis of the data between the same stages in the three groups revealed significant difference in serum protein on 2 and 30 days postpartum and also on the day of oestrous. Pairwise comparison of data on serum protein at 2 days postpartum revealed that only treatment I and II were heterogeneous. On the other hand, at 30 days postpartum the control and treatment I were found to be heterogeneous. On the day of oestrus heterogeneity was observed between control and treatment I; and treatment I and treatment II. Significant difference in the levels prior to oestrum and on the day of postpartum oestrus in both control and treatment I was also noticed.

The levels of serum glucose at 2, 15, 30 and 45 days postpartum in the control were 57.40 ± 5.60, 53.42 ± 3.98, 54.98 ± 2.43 and 53.02 ± 1.77 mg per cent respectively. The corresponding levels in treatment I were 55.51 ± 4.26, 50.58 ± 3.92, 36.55 ± 6.09 and 53.08 ± 2.47 mg per cent and those of treatment II were 63.08 ± 4.07, 57.22 ± 2.75, 54.90 ± 1.50 and 57.85 ± 1.86 mg per cent. The levels on the day of oestrum were 57.20 ± 2.75, 61.04 ± 3.58, and 60.94 ± 2.19 mg per cent in control, treatment I and treatment II respectively. Statistical analysis of the data revealed no significant variation in serum glucose level between corresponding stages of the 3 groups except at 30 days postpartum. It was also revealed that both control and treatment I; and treatment I and treatment II were heterogeneous groups. Normal standard error difference test showed significant difference in the values before oestrus and on the day of oestrus in treatment II.

The haemoglobin levels at 2, 15, 30 and 45 days postpartum were 11.10 ± 00.40, 11.52 ± 00.62, 11.58 ± 00.54 and 11.20 ± 00.86 g per cent respectively in control; 11.64 ± 00.73, 12.42 ± 00.51, 12.15 ± 00.60 and 13.00 ± 00.12 g per cent respectively in treatment I and 12.48 ± 00.53, 12.52 ± 00.57, 11.80 ± 00.61 and 11.63 ± 00.40 g per cent respectively in treatment II. The levels on the day of oestrum were 11.52 ± 00.61, 13.28 ± 00.12, and 12.78 ± 00.35 g per cent in the control, treatment I and treatment II respectively. Statistical analysis revealed no significant variation in the levels of haemoglobin between the corresponding stages of the 3 groups except on the day of postpartum oestrum. Further, control and treatment I; and control and treatment II were found to be heterogeneous. There was also significant difference between haemoglobin levels prior to oestrum and on the day of oestrum.

The fact that there was no significant variation in postpartum body weight and the onset of first postpartum oestrum between the groups points out that the ration prescribed based on Sen and Ray standard is quite adequate not only to meet the production requirement but also to meet the need for optimum reproductive performance. The observation that the levels of serum inorganic phosphorus, protein, glucose and percentage haemoglobin in all the 3 groups were much higher than those of anoestrous cows but at the same time well within the normal physiological range clearly substantiates the above finding.

REFERENCES

REFERENCES

Anonymous (1973). Progeny testing of bulls in Sweden Svensk Husdjurs Skotsel.

Arthur, G.H. (1975). Veterinary Reproduction and Obstetrics. Bailliere Tindall, London. 4th Ed. pp.450 -

Axelson, A. and Morley, F.H.W. (1976). The effect of plane of nutrition on reproductive performance of early weaned heifers. Proc. Aust. Soc. Anim. Prod. 11 : 241 - 244.

Baker, A.A. (1967). Pattern of oestrous behaviour in Sahiwal - Shorthorn heifers in South Eastern Queensland. Aust. vet. J. 43 : 140 - 144.

Baker, A.A. (1969). Postpartum anoestrus in cattle. Aust. vet. J. 45 : 180 - 183.

*Bedrak, E., Warnick, A.C., Hentges, J.F. (Jr.), and Cunha, T.J. (1966). Effect of protein intake on gains, reproduction and blood constituents of beef heifers. Tech. Bull. Fla agric. Exp. Stn. No.678 ; pp. 30. Anim. Breed. Abstr.(1966) 34 (3) abstr. no. 2038.

Benjamin, M.M. (1974). Outline of Veterinary Clinical Pathology. The Iowa State University Press, USA 2nd Ed. pp.56.

Bhaskaran, K.V., Iyer, C.P.N. and Madhavan, E. (1982). Effect of body weight changes during postpartum period in the reproductive performance of cross-bred cows. Kerala J. Vet. Sci. 13(2) 337 - 340.

Bhatia, S.K., Ahuja, A.K., Poonia, R.S., and Rao, A.R. (1972). A note on the comparative study of some blood constituents of Hariana and cross-bred (Holstein-Friesian X Haryana) calves. Indian vet. J. 49 (6) : 568 - 571.

Blood, D.C., Henderson, J.A., and Radostits, O.M. (1979). Veterinary Medicine. Bailliere Tindall, London. 5th Ed.

Bond, J. and Weiland, B.T. (1978). Effect of level of feeding on growth, reproductive performance and milk production of beef females. Livest. Prod. Sci. 5 (2) : 159 - 169.

Boyd,C.J. (1970). Managing dairy cattle for fertility. J. Dairy Sci. 53(7): 969.

Boyd,H. (1977). Anoestrus in cattle. Vet. Rec. 100 (8) 150 - 153.

Brochart,M., Gaulliard,D. and Girou,R. (1972). Energy and Nitrogen intake on fertility in milk cows. Proc. VIIth International Cong. on Anim. Rep. and A.I. pp.1737.

Carroll,E.J., and Hoelein,A.B. (1966). Reproductive Performance of beef cattle under draught condition. J. Am. vet. med. Ass. 148 : 1030 - 1033.

Chandler,P.T., Brown,C.A., Johnston (Jr.),R.P., Macleod,G.K. and McCarthy,R.D. (1956). Protein and methionine hydroxy analog for lactating cows. J. Dairy Sci. 59 (11) : 1897 - 1909.

Chapman,A.B. and Casida,L.E. (1937). Analysis of variation in the sexual cycle and some of its component phase with special reference to cattle. J. Agr. Res. 54 : 417.

Chaturvedi,M.L. (1972). Rate of growth and attainment of maturity in Hariana heifers as affected by systems of feeding. Indian Vet. J. 49 (5) : 482 - 486.

Chrichton,J.A., Aitken,J.N. and Boyne,A.W.(1959). The effect of plane of nutrition during rearing on growth, production, reproduction and health of dairy cattle, I. Growth to 24 months. Anim. Prod. 1: 145 - 152.

Cuenca,L.(1973). Infertility problem of beef cattle in Uruguay. Compendium. Tenth FAO/Sweedish International Postgraduate Veterinary Course on Animal Reproduction, Stockholm. IV : 1 - 6.

Dawson,F.L.M. (1970). Infertility in beef cattle. Vet. Bull. 40 (1) : 817 - 827.

Deas,D.W., Laing,J.A., Melrose,D.R., Reed,H.C.B. and Vandeplassche (1979a). 'Management of ovarian function' in Fertility and Infertility of Domestic Animals. Bailliere Tindall, London. 3rd Ed. pp.116.

Deas,D.W., Melrose,D.R., Reed,H.C.B., Vandeplassone,M., and Pidduck,H. (1979b). Other non-infectious abnormalities in Fertility and Infertility of Domestic Animals.(ed. Laing,J.A.). Bailliere Tindall, London. 3rd Ed. pp. 139.

*Dedeckova - Salova (1974). The effect of a temporary and permanent 40% reduction of nutrition on performance of heifers. Zivocisna Vyroba (1974): 19(5): 337 - 348. Anim. Breed. Abstr. (1975): 43 (4) abstr. no. 1059.

deKrulf,A. (1978). Factors influencing the reproductive capacity of a herd. N. Z. vet. J. 26 : 183 - 189.

Deshpande,B.R. and Sane,C.R. (1977). Prolonged postpartum anoestrum in cows. Indian vet. J. 54(1) : 63 - 68.

Deshpande,B.R., Patil,J.S., and Sane,C.R. (1978). Relative importance of total serum protein, blood glucose and body weight in assessment of reproductive status during antepartum and postpartum periods in Gir cows. Paper presented at the FAO/SIDA Follow-Up Seminar on Animal Reproduction. Thirupathi, 1978.

Deshpande,B.R., Velnankar,D.P., Jadhav,D.S. and Sane,C.R. (1981). Nutrition in relation to reproduction in females. Indian J. Anim. Reprod. 1(1) : 23 - 26.

DeVaccaro,L.P. (1973). Some aspects of the performance of purebred and cross-bred dairy cattle in tropics. Part I. Reproductive efficiency in females. review Anim. Breed. Abstr. 41 (12) : 571 - 589.

Donaldson,L.E., Ritson,J.B. and Copeman,D.B. (1977). The reproductive efficiency of several north Queensland beef herds. I. Physiological and management factors and embryonic. neonatal losses. Aust. vet. J. 43 : 1 - 6.

Donaldson,L.E. (1977). Some causes of wastage in beef cattle artificial breeding. Aust. vet. J. 53 : 78 - 81.

Downine,J.G. and Gelman,A.C. (1976). The relationship between changes in body weight, plasma glucose and fertility in beef cows. Vet. Rec. 99(11) : 211 - 212.

Drew, B. (1977). 'Management factors in oestrous cycle control' in control of Reproduction in the cow. A seminar in the EEC Programme of Co-ordination of research on beef production. Galway, 1977. (ed. Sreenan, J.R.). pp. 475.

Dubowski, K.M. (1962). Clinical chemistry 8 : 215 cf. Pilleggi, V.J. and Christopher, P.S. (1974). 'Carbohydrates' in Clinical Chemistry, Principles and Techniques. 2nd Ed. (ed. Henry, R.J., Cannon, D.C., and Winkelman, J.W.). Harper and Row, New York. 2nd Ed. pp. 1285.

Dunn, I.G., Ingalls, J.E., Zimmerman, D.R. and Wiltbank, J.J. (1969). Reproductive performance of 2-year-old Hereford and Angus heifers as influenced by pre - and post-calving energy intake. J. Anim. Sci. 29 : 719 - 726.

Dukes, H.H. (1970). Duke's Physiology of Domestic Animals Animals. 8th Ed. Comstock Publishing Associates, Ithaca and London pp. 1463.

Fallon, G.R. (1958). Some aspects of oestrum in cattle with reference to fertility on A.I. I. The pattern of oestrous cycle. The Queensland J. Agri. Sci. 15 : 25 o.f. Res. Bull (1968) : 270 : 3 - 4.

*Feoktistov, L.I. (1972). Protein feeding level of cows and their reproductive ability. Zhivotnovodstvo Mosk. 34 (1) : 76 - 79. Anim. Breed. Abstr. (1972) 40 : abstr. no. 4385.

Fiske, C.H. and Subbarow, Y. (1925). The colorimetric determination of phosphorus. J. Biol. Chem. 66 : 375.

Folman, Y., Rosenberg, M., Herz, Z., and Davidson (1973). The relationship between plasma progesterone concentration and conception in postpartum dairy cows maintained on two levels of nutrition. J. Reprod. Fert. 34 : 267 - 278.

Francis, E.C. and Raja, C.K.S.V. (1971). A study on the genital involution in Sindhi cows. Kerala J. vet. Sci. 2 (2) : 113 - 118.

Fuquay, J., Bakes, A.H., Ulberg, L.C. and Davenport, D.G. (1966). Effects of high levels of energy intake during early lactation on the reproductive performance of dairy cows. J. Dairy Sci. 49 : 447 - 448.

Fuquay, J.W., McGee, W.H., and Custer, E.W. (1975). Effect of methionine hydroxy analog on postpartum interval and reproductive efficiency in dairy cattle. J. Dairy Sci. 58 (1) : 139.

Garden, S. (1975). Production disease control. Three dairy herd case studies in N.E. Scotland. Vet. Rec. 96 : 461 - 464.

Gardner, R.W. (1969). Interactions of energy levels offered to Holstein cows prepartum and postpartum. II. Reproductive performance. J. Dairy Sci. 52 : 1985 - 1987.

Gleeson, P.A. (1972). Effect of plane of nutrition on spring born calves during their first winter and their subsequent growth rate and reproductive performance. Irish J. agri. Res. 11 (1): 31 - 39.

Gonzaga, A.C., and Vergara, J.S. (1956). Blood sugar, inorganic phosphorus and serum calcium of Jersey cattle in Philippines. Indian vet. J. 33 (1): 11.

Gornal, A.G., Bardawill, C.J. and David, M.M. (1949). J. Biol. Chem. 177 : 751 cf. Mark, D.D. and Zimmer, A. (1967). Atlas of Clinical Laboratory Procedures. I. Clinical Chemistry. McGraw Hill Publishing Co., New York. pp. 132.

Grainger, C. and Wilhelms, G. (1978). Effect of postcalving feeding on milk production and reproduction. Proc. Aust. Soc. Anim. Prod. Victoria. 12 : 228.

*Grainger, C. and Wilhelms, G. (1979). Effect of duration and pattern of underfeeding in early lactation on milk production in dairy cows. Aust. J. Expt. Agri. Anim. Husb. 19 : 395 - 400. Anim. Breed. Abstr. (1980): 48 (5). abstr. no.2452.

Harrock, D. and Patterson, J.Y.F. (1957). Further observations on blood components in the lactating dairy cattle. J. Comp. Path. 70 : 109 - 114.

Hewett, C.D. (1972). Blood profile as a possible means for diagnosing non-infectious infertility in dairy cows. Proc. VIIth International Cong. on Anim. Reprod. and A.I. I.

Hignett, S.L. and Hignett, P.G. (1951). The influence of nutrition on reproductive efficiency in cattle. Vet. Rec. 63 (38) : 603 - 611.

Hollon, B.F. and Branton, C. (1971). Effect of early post-partum weight changes on reproductive performance of dairy cattle. J. Dairy Sci. 54 (5): 787 - 788.

*Holness, D.H., Dale, D.H. and Hopley, J.D.H. (1980). Ovarian activity and conception during the postpartum period in Africander and Mashona cows. Zimbabwe J. Agri. Res. 18 (1) : 3 - 11. Anim. Breed. Abstr. (1980). 48 (12) abstr. no. 7239.

*Howes, J.A., Hentges, J.F. (Jr.), Warnick, A.C. and Cunha, T.J. (1963). Comparative growth and reproduction of Hereford and Brahman cattle in Florida. Q. F. Fla Acad. Sci. 26 : 368 - 381. Anim. Breed. Abstr. (1964) 32 (3) abstr. no. 1907.

Hughes, J.H., Stephens, D.F., Lusby, K.S., Pope, L.S., Whiteman, J.V., Smithson, L.J., and Totusek, R. (1978). Long-term effects of winter supplement on the productivity of range cows. J. Anim. Sci. 47 : 816 - 827.

Hultman, E. (1959). Nature. 183 : 108 cf. Pillegi, V.J. and Christopher, P.S. (1974). "Carbohydrates" in Clinical Chemistry, Principles and Techniques. (ed. Henri, R.J., Cannon, D.C. and Winkelman, J.W.). Harper and Row. New York. 2nd Ed. pp. 1285.

Hyravinen, A. and Nikkila, E.A. (1962). Clin. Chem. Acta. 7 : 140 cf. Pilleggi, V.J. and Christopher, P.S. (1974). "Carbohydrates" in Clinical Chemistry, Principles and Techniques. (ed. Henri, R.J., Cannon, D.C., Winkelman, J.W.) Harper and Row, New York. 2nd Ed. pp. 1285.

*Ishii,K., Tsunematsu,S. and Morita,Z.(1980). Effect of high level of nutrition during rearing on growth and nutrition in Japanese Black cattle. Bull. of the Fac. of Agri. Tattori Uni. 32 : 37 - 43. Anim. Breed. Abstr. (1981) 49 (1): abstr. no. 90

Inskeep,E.K. and Lishman,A.W. (1979). 'Factors affecting postpartum anoestrus in beef cattle'. in Beltsville Symposia in Agricultural Research 3 Animal Reproduction. Allanheld, Osmun and Co., New Jersey.

Jainudeen,M.R. and Hafez,E.S.E. (1980). 'Reproductive failure in females' in Reproduction in Farm Animals 4th Ed (ed. Hafez, E.S.E.) Lea and Febiger, Philadelphia p.452.

Jordon,E.R. and Swanson,L.V. (1979). Effect of crude protein on reproductive efficiency, serum total protein and albumin in the high producing dairy cows. J. Dairy Sci. 62 (1) : 58 - 63.

Jorden,E.R. and Swanson,L.V. (1979b). Serum progesterone and luteinizing hormone in dairy cattle fed varying levels of crude protein. J. Anim. Sci. 48 (6) : 1154 - 1158.

Joubert,D.M. (1963). Puberty in farm animals. review. Anim. Breed. Abstr. 31 (3) : 295 - 306.

King,J.O.L. (1968). The relationship between the conception rate and changes in body weight, yield and SNF content of milk in dairy cows. Vet. Rec. 83 (19): 492 -494.

King,J.O.L. (1971). Nutrition and fertility in dairy cows. Vet. Rec. 89 : 320 - 324.

Kodagali, S.B. (1981). Problems of anoestrous condition in the bovines. Indian J. Anim. Reprod. 1 (1): 1 - 16.

Lamond,D.R. (1969). Sources of variation in reproductive performance in selected herd of beef cattle in north-eastern Australia. Aust. vet. J. 45 : 50 - 58.

Lamond,D.R. (1970). The influence of undernutrition on reproduction in the cow. Review. Anim. Breed. Abstr. 38 (3) : 359 - 372.

Leaver, J.D. (1977). Rearing of dairy cattle 7. Effect of level of nutrition and body condition on the fertility of heifers. Anim. Prod. 25 (2) : 219-224.

*Little (1975). Effects of dry seasons supplements of protein and phosphorus to pregnant cows on the incidence of first postpartum oestrus. Aust. J. Exp. Agri. Anim. Hus. 15 (72) : 25 - 31. Anim. Breed. Abstr. (1975) 43 (11) abstr. no. 5153.

*Lopez, S. and Martinez, N. (1981). Effect of prepartum supplement for Holstein-Friesion heifers. Effecto de la suplementacion pre-parto en novillas Holstein 35 - 36. Anim. Breed. Abstr. (1981) 48(4) : abstr. no. 4406.

Mathai, E. and Raja, C.K.S.V. (1976). A study on the growth rate and age at puberty of Jersey - Sindhi females under different regime of feeding. Kerala J. Vet. Sci. 7(2) : 114 -123.

Maynard, L.A. and Loosli, J.K. (1973). Animal Nutrition. Tata - McGraw - Hill Publishing Co., Delhi. 6th Ed. pp.494.

McClure, T.J. (1965). Experimental evidence for the occurrence of nutritional infertility in otherwise clinically healthy pasture fed lactating dairy cows. Res. vet. Sci. 6 : 202 - 208.

McClure, T.J. (1968). Malnutrition and infertility of cattle in Australia and New Zealand - review. Aust. vet. J. 44 : 134 - 138.

McClure, T.J. and Dowell, A.E. (1969). Survey of dairy herds in the Moss Vale District of New South Wales. 2. Fertility of herds. Aust. vet. J. 45 : 41 - 45.

McClure, T.J. (1970). An experimental study of the causes of nutritional and lactation stress infertility of pasture-fed cows, associated with loss of body weight at about the time of mating. Res. Vet. Sci. 11 : 247 - 254.

McClure, T.J. (1972). Blood glucose and female fertility. Vet. Rec. 91 : 193.

McDonald,L.E. (1975). Veterinary Endocrinology and Reproduction. 2nd Edn. Lea and Febiger, Philadelphia. pp.325.

McTaggart,N.S. (1961). Relationship between the level of milk production and fertility of dairy cows at grass. Vet. Rec. 73 : 801 - 804.

Mishra,S.K. and Biswal,N. (1961). Some haematological values of normal Orissa cattle. Indian vet. J. 38 (6) : 296.

Mitruji,G.C., Shukla,P.C. and Patel,B.M. (1962). Haematological studies in Kankrej breed. Indian vet. J. 43 (7) : 605 - 612.

Mokashi,B.G., Deshpande,B.R. and Sane,C.R. (1974). Study of postpartum anoestrous condition and effectiveness thereon of the increased energy intake. Indian vet. J. 51 : 671 - 675.

Morrow,D.A., Tyrrell,H.F., and Trimberger,G.W. (1969). Effects of liberal concentrate feeding on reproduction in dairy cattle. J. Am. vet. med. Ass. 155 : 1946 - 1954.

Morrow,D.A. (1970). Diagnosis and prevention of infertility in cattle. J. Dairy Sci. 53(7) : 961 - 971.

Morrow,D.A. (1977). Nutrition : Reproductive relationship in dairy cattle. Paper presented at the First All India Symposium on Anim. Reprod. at Ludhiana.

Morrow,D.A. (1980). Nutrition and fertility in dairy cattle. Mod. vet. Pract. 6 : 499 - 503.

Moustgaard,J. (1969). Nutrition influence upon Reproduction in Reproduction in Domestic Animals. 2nd Ed. (ed. Cole, H.H. and Cupps, P.T.). Academic Press, New York. pp.489.

Mulvehill,P. and Sreenan,J.M. (1977). Oestrous cycle control and fertility in beef cattle following short-term progesteron treatments. Control of reproduction in the cow. A seminar in the EEC Programme of Co-ordination of research in beef production held at Galway. (ed. Sreenan,J.R.). Martinus Nijhoff - London.

Murtuza, Md., Pandey, M.D. and Rawat, J.S. (1979). Concentration of certain minerals in the serum of Haryana cattle under various physiological state. Indian vet. J. 56 (2) : 95 - 99.

Nair, S.P.S. (1979). Studies on postpartum oestrum in cross-bred cows. M.V.Sc. Thesis, Kerala Agricultural University, Mannuthy.

*Nicol, A.M. (1977). The influence of plane of nutrition, immediately post-calving, on the performance of beef cows. N. Z. Soc. Anim. Prod. 37 : 103 - 108. Nutr. Abstr. Rev. Series B (1978) 48 : abstr. no.3961.

Oxenreider, S.L. and Wagner, W.C. (1971). Effect of lactation and energy intake on postpartum ovarian activity in cow. J. Anim. Sci. 33 : 1026 - 1031.

Patil, J.S. (1976). Studies on estimation of total serum protein, blood glucose, haemoglobin content and body weight during antepartum, parturition and postpartum periods for prediction of the reproductive status in Gir cows. M.V.Sc. Thesis, Konkan Krishi Vidyapeeth, Dapoli.

Patil, J.S. and Deshpande, B.R. (1979). Changes in body weight, blood glucose and serum protein to the appearance of postpartum oestrum in Gir cows. J. Reprod. Fert. 57 (2) 525 - 527.

Patil, J.S. and Deshpande, B.R. (1981). The study of body weight changes during antepartum and postpartum period in Gir cows with special reference to exhibition of postpartum heat. Indian vet. J. 58(5) 376 - 379.

Payne, J.M., Dew, S.M., Manston, R. and Faulks, M. (1970). The use of metabolic profile test in dairy herds. Vet. Rec. 87 : 150 - 158.

*Penzhorn, E.J. and Kemm, E.H. (1973). The influence of supplementary feeding on conception rate of young Africander cows. South Afri. J. Anim. Sci. 3 (1) 23. Nutr. Abstr. Rev. (1974). 44 : abstr. no.3594.

Pillai Vijayakrishna, G.P. (1980). Studies on anoestrum in cross-bred cattle. M.V.Sc. Thesis, Kerala Agricultural University, Mannuthy.

Rao Vikunta,S. and Rao Ramamohana,A. (1982). Certain blood constituents of prepuberal and cycling cross-bred heifers. Indian vet. J. 59 (8) 619 - 622.

Rattan,P.J.S., Singh Ranjit and Anant Krishna,C.P. (1966). Haematological constituents of Sindhi and cross-bred cows. Indian J. Dairy Sci. 19 : 191.

Rattray,P.V. (1977). Nutrition and reproductive efficiency in Reproduction in Domestic Animals. 3rd Ed. (ed. Cole,H.H. and Cupps,P.T.). Academic Press, New York, pp.553.

Richardson,F.D., Oliver,J. and Clarke,G.P.Y. (1976). Analysis of some factors which affect the productivity of beef cows and their calves in a marginal rainfall area of Rhodesia.I. Factors affecting calving rate. Anim. Prod. 21 : 41.

Roberts,S.J. (1971). Veterinary Obstetrics and Genital Diseases. 2nd Ed. CLS Publishers and Distributors. Delhi. pp. 453.

*Saiko,A.A. and Krukovets,M.K. (1976). Effect of supplementary methionine on reproductive functions of cow. Zhivotnovodstvo No.12, 62 - 64. Nutr. Abstr. Rev. Series B (1977) 47 : abstr. no.5757.

Salisbury,G.W. and VanDemark,N.C. (1961). Physiology of Reproduction and Artificial Insemination of cattle. W.H. Freeman and Co., San Francisco. pp.581.

Samad,A., Ali,K.M. and Rehman,A. (1980). Studies on certain blood constituents of anoestrous cattle. Indian vet. J. 57 (2) : 135 - 138.

Sane,C.R. (1972). Prolonged postpartum anoestrous condition of Gir cows. Paper presented at the FAO/Swedish follow up seminar on animal reproduction, Bangalore.

Sattar,A. (1973). Problems of infertility in cattle in Assam. Compendium. 10th FAO/Swedish International P.G. course on Anim. Rep. IV : 1 - 5.

Scharp,D.W. (1979). Effect of adding superphosphate to drinking water on fertility of dairy cows. Aust. vet. J. 55(5) : 240 -243.

Sen, K.C. and Ray, S.N. (1971). Nutritive value of Indian Cattle Feeds and the Feeding of Animals. Indian Council of Agricultural Research, New Delhi. 6th Ed.

Singh, R.B., Akthar, M.H., Biswas, S.C. and Yadava, R.H. (1978). Combined therapy of Tonophosphan and Prepalilin forte in anoestrous heifers. Indian vet. J. 55(2) : 157 - 160.

Snedecor, G.W. and Cochran, W.G. (1967). Statistical Methods. 6th Ed. Oxford and I.B.M. Publ. Co., New Delhi. pp. 163 - 171.

Somerville, S.H., Lowman, B.G. and Deas, D.W. (1979). The effect of plane of nutrition during lactation on the reproductive performance beef cow. Vet. Rec. 104 : 95 - 97.

Sonderegger, H., and Schurch, A. (1977). A study of the influence of the energy and protein supply on the fertility of dairy cows. Livest. Prod. Sci. 4 (4) 327 - 333.

Speth, C.F., Bohman, V.R., Melendy, H., and Wade, M.A. (1962). Effect of dietary supplements on cows on a semi-desert range. J. Anim. Sci. 21 : 444 - 448.

Swanson, E.W. (1967). Optimum growth patterns for dairy cattle. J. Dairy Sci. 50 : 244 - 252.

Topps, J.H. (1977). The relationship between reproduction and undernutrition in beef cattle. Wld. Rev. Anim. Prodt. 13 (2) 43 - 49.

Trimberger, G.W. (1956). Ovarian functions intervals between oestrus and conception rate in dairy cattle. J. Dairy Sci. 39 : 448.

Turton, J.D. (1969). Recent research in cattle breeding and production in the USSR - review. Anim. Breed. Abstr. 37 (3) : 347-391.

Velhankar, D.P. (1978a). Studies on puberty in Gir heifers consequential to different dietary energy levels. Paper presented at the FAO/SIDA Follow up Seminar on Animal Reproduction, Tirupathi.

Velhankar, D.P. (1978b). Studies on blood glucose and serum cholesterol levels in relation to puberty and sexual maturity in Gir heifers consequential to different dietary energy levels. Paper presented at the FAO/SIDA Follow up Seminar on Animal Reproduction, Tirupathi.

Vujovic, R., Jovanil, D. and Grus. I. (1972). Some problems of reproduction in dairy cows in large farms. Proc. VIIth International Cong. on Anim. Rep. and A.I. II 1243 - 1246.

Wagner, W.C. (1972). Improving fertility in dairy cows. J. Am. vet. med. Ass. 140 (9) : 939.

Ward, H.K. (1968). Supplementation of beef cows grazing on veld. Rhod. J. agric. Res. 6 : 93 - 103.

Ward, H.K. and Tiffin, J. deW (1975). Progress in beef cow productivity. cited by Topps (1977). Wld. Rev. Anim. Prodt. 13(2) : 43 - 43.

Warnick, A.C. (1955). Factors associated with the interval from parturition to first oestrus in beef cattle. J. Anim. Sci. 14 : 1003 - 1011.

* Warnick, A.C., Kogar, M., Martinez, A. and Cunha, T.J. (1965). Productivity of beef cows as influenced by pasture and winter supplements during growth. Bull. Fla agric. Exp. Stn. No.695 : pp.15. Anim. Breed. Abstr. 36 : abstr. no. 2561.

Wiltbank, J.N., Rowden, W. A., Ingalls, J.E. and Zimmerman, D.R. (1964). Influence of postpartum energy level on reproductive performance of Hereford cows restricted in energy in-take prior to calving. J. Anim. Sci. 23 : 1049 - 1053.

Wiltbank, J.N. (1972). Management of heifer replacement and the brood cow herd through the calving and breeding periods in Commercial Beef Cattle Production (ed. O.Mar.,C.C. and Dyer, I.A.). Lea and Febiger, Philadelphia pp.150.

EFFECT OF DIFFERENT DIETARY LEVELS ON THE POSTPARTUM REPRODUCTIVE PERFORMANCE OF CROSS-BRED COWS

By

M. I. ALEXANDER

ABSTRACT OF A THESIS

Submitted in partial fulfilment of
the requirement for the degree

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University

Department of Animal Reproduction
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy - Trichur

1983

ABSTRACT

The object of the present study was to assess the influence of higher dietary levels on the postpartum reproductive performance of cross-bred cows.

The materials consisted of 30 crossbred cows in advanced stage of gestation. They were weighed on 270th day of gestation and on the day of calving and were randomly alloted to control, treatments I and II. The control received ration based on Sen and Ray standard whereas, treatments I and II received 115 and 130 percent of control ration. The weight of the cows was recorded at 15 days interval from calving to oestrum. Serum inorganic phosphorous, protein, glucose and haemoglobin percentage of 5 cows from each group was estimated.

A decline in body weight was observed in the first fortnight in all the three groups. This trend continued upto 30 days in the control whereas, in the treatments an increasing trend was observed from fifteenth day. Cows in all three groups showed postpartum oestrum, while there was gain in body weight. The postpartum oestrous interval of control, treatment I and treatment II were 62.1 ± 4.63, 56.60 ± 5.53 and 53.22 ± 3.75 days respectively and these values did not vary significantly. However, postpartum oestrous interval of treatments I and II was significantly less than that of the herd.

Serum inorganic phosphorous was significantly higher on the day of oestrum in control and treatment II. There was significant difference in serum protein values between groups at certain time intervals. It was also significantly more on the day of oestrum in both control and treatment I. Similarly blood glucose and haemoglobin were significantly higher on the day of oestrum in treatment I.

Results of this study indicated that Sen and Ray ration is adequate to meet the requirement for both production and reproduction of cross-bred cows.