STUDIES ON ANOESTRUM IN CROSSBRED CATTLE

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "STUDIES ON ANOESTRUM IN CROSSBRED CATTLE" 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,
11.7.1980.

G.P. VIJAYAKRISHNA PILLAI.

CERTIFICATE

Certified that this thesis entitled " STUDIES ON ANOESTRUM IN CROSSBRED CATTLE" is a record of research work done independently by Sri. C.P. Vijayakrishna Pillai 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.

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DEDICATED TO THE LOVING MEMORY

OF

MY BELOVED TEACHER

DR. T.R. BHARATHAN NAMBOODIRIPAD

INTRODUCTION

INTRODUCTION

The cattle population of Kerala, according to 1977 census is 3.01 millions, out of which 14.7 lakhs are breedable cows and heifers. There had been a considerable increase in the number of crossbred cattle during the last decade and at present about 50 per cent of the stock of breedable cows are crossbreds. It is assumed that by 1980, the entire cattle population of the State will be crossbreds (Anon, 1980).

It is an accepted fact that, the production capacity of cattle to a great extent depends on the reproductive efficiency, as measured by its ability to conceive and deliver a viable calf each year, during her lifespan. Productive efficiency of cattle or any livestock reduced on account of disturbances in reproduction, constitutes infertility. Infertility has been and continues to be one of the impeding factors that retard the progress of cattle industry (Iyer, 1978).

Anoestrum is the most common cause of infertility in cattle (Vandeplassche, 1972; Luktuke and Sharma, 1973; Naikini *et al*. 1978a; Iyer, 1978; Chauhan and Singh, 1979; Deas *et al*., 1979a). In a number of instances, the magnitude of anoestrum is so high, that it has become a limiting factor in the economic maintenance of dairy cattle.

Rao and Murthy (1972) reported that 67.71 per cent of the incidence of infertility was due to physiological causes, out of which 72.2 per cent was 'true anoestrum'. Luktuke and Sharma (1978) observed an incidence of 36.16 per cent and 43 per cent of infertility among heifers and cows respectively due to smooth and inactive ovaries.

According to the available reports, the problem of infertility due to anoestrum is more serious than due to other causes in Kerala also. Namboodiripad (1978), on the basis of the data collected from the anti-sterility camps in the State, reported an incidence of 76.99 per cent infertility due to anoestrum. Mathew and Namboodiripad (1979) observed 21 to 58 per cent of anoestrum among the crossbred cattle of varying exotic blood levels.

Several therapeutic measures like allopathic including hormonal, ayurvedic, homeopathic, physical and even electrical treatments have been tried by various workers to combat this condition (Hays and Carlevaro, 1956; Dinorkar and Kohli, 1973; Deshpande et al., 1976; Porwal et al., 1976; Kaikini et al., 1978a; Patil and Khan, 1978). But a systematic approach to ward off this problem appears to be scanty. Perusal of the available literature also does not throw much light on the problem of anoestrum among crossbred cattle. Hence a study was undertaken to investigate the incidence,

nature, magnitude of prevalence and etiological factors for anoestrum among crossbred cattle in the State, and to find out suitable corrective measures to combat this problem.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

"Anoestrum is a period of sexual quietude in which there is complete absence of sexual cycle with no manifestation of heat. It is normal for cattle to be anoestrous before puberty, during pregnancy and a short period after calving" (Arthur, 1975).

According to the nature of ovaries, Roberts (1971) classified anoestrous cattle into two classes, Class I - cows with a functional corpus luteum in any one of their ovaries and Class II - with no functional corpora lutea in their ovaries. He included in Class I, cows that were pregnant, those with persistant or retained corpus luteum and those with were ovulating and cycling regularly, but with a silent oestrum. In Class II he included cows which were actually in oestrum (silent), approaching or recently in oestrum, cows in anoestrum due to failure of oestrous cycle, cows with cystic ovaries and cows with conditions such as freemartinism, ovarian hypoplasis, ovarian tumours and pituitary disturbances. Arthur (1975) described 'true anoestrum' as the condition in which both the ovaries were smooth and inactive with no palpable structures and cyclical activity.

The incidence of anoestrum in cattle was reported to be 3.6 per cent (Trimberger, 1956) and 12.13 per cent (Khan and

Luktuke, 1967). Zemjanis (1970) observed an incidence of 12.6 per cent of pre-service anoestrum and 30.8 per cent of post-service anoestrum. In an abattoir study of 1728 bovine genitalia, Luktuke et al. (1972) observed that in 14.69 per cent both the ovaries were smooth and inactive while Nair (1973) could observe only 2.24 per cent of quiescent ovaries in a similar study. Among rural cattle, Luktuke and Sharma (1978) observed 'true anoestrum' in 36.16 per cent of heifers and 43 per cent of cows.

Sane (1972) reported an incidence of 22.2 per cent of postpartum anoestrum in a herd of Gir cows under rigid sexual health control. Rao and Murthy (1972) reported that 67.7 per cent of infertility was due to physiological causes out of which 72.2 per cent was true anoestrum. Araujo et al. (1973) reported that 17.5 per cent of anoestrous cows were in true anoestrum. Namboodiripad (1977) reported an incidence of 12.6 per cent of post-service anoestrum. Patil and Khan (1978) observed 30 per cent incidence of anoestrum. Ansari (1978) reported that only 31 per cent of the anoestrous cattle were in 'true anoestrum', while Iyer (1978) reported that 70 per cent of reported cases of anoestrum among cows and 90 per cent among heifers were actually 'true anoestrum'. According to Patel (1979) the incidence of 'true anoestrum' was 13.61 to 51.29 per cent among cattle.

Namboodiripad (1978) reported that 76.99 per cent of the cases presented in the antisterility camps was with the complaint of anoestrum, but on detailed examination it was observed that 8.8 per cent was pregnant and 10.8 per cent was unobserved oestrum. Anoestrum due to ovarian hypoplasia was 4.39 per cent. Jain (1979) reported 52.4 per cent anoestrum. Among crossbred cattle, Hollan and Branton (1975) observed 19 to 30.4 percent anoestrum, while Sudarsanan (1979) could observe 70 per cent true anoestrum among crossbred cattle.

Mathew and Namboodiripad (1979) observed 23.07 to 41.42 per cent anoestrum cases in cows and 20.00 per cent to 51.72 per cent cases in heifers, depending upon the level of exotic blood among Brown-Swiss crossbred cattle at Mavelikkara.

Rao and Murthy (1971b) reported 41.23 per cent incidence of 'true anoestrum' while Luktuke and Sharma (1978) observed 32.8 and 56 per cent of 'true anoestrum' among she buffaloes and heifers respectively. Chaudhari et al. (1978) recorded 31.28 per cent anoestrum in buffaloes which included 63 per cent of 'true anoestrum', 34.59 per cent of silent heat and 2.4 per cent of retained corpora lutea. After an elaborate survey of 900 reproductive cycles of buffaloes, Chauhan and Singh (1979) reported 71 per cent of anoestrum. Pre-service anoestrum was 46.6 per cent and post-service

anoestrum 24.4 per cent, but the incidence of 'true anoestrum' was 30.5 per cent only.

Namboodiripad and Luktuke (1978) observed that in anoestrous buffaloes the ovaries weighed less with reduced amount of follicular fluid. The Graafian follicles were smaller, fewer in number and were atretic. The gonadotrophic potency and the concentration of gonadotrophs were less in pituitary gland. The serum leutinising hormone (LH) levels of anoestrous animals were observed to be considerably less when compared with normal cycling animals (Kodagali, 1978; Kodagali and Deshpande, 1978; Rao et al., 1979; and Kodagali et al., 1980). Kaikini et al. (1976b) reported that in anoestrous cows, progesterone was barely detectable in peripheral blood.

Luktuke et al. (1979) also reported that the endocrine glands of anoestrous buffaloes revealed evidence of at least inoptimal functional status and were generally low in weight. Contrary to this, Foote (1974) reported that the pituitary LH activity, which was low at calving, increased throughout anoestrum, whereas Follicle Stimulating Hormone (F.S.H.) activity of pituitary showed a reverse of this. He postulated that postpartus anoestrum could be due to inadequate release of pituitary gonadotrophin, and low ovarian sensitivity.

Malnutrition or undernutrition could be one of the most

important causes for reproductive failures, by reducing the secretion of pituitary gonadotrophins (Lamond, 1970). Concha (1973) reported that the main etiological factor for anoestrum is various nutritional deficiencies.

Low energy ration could depress ovarian function and thus cause anoestrum (Dawson, 1970; Boyd, 1970; King, 1971; Roberts, 1971 and Deas et al., 1979b). Brochart et al. (1972) observed that both energy and nitrogen, excess or deficiency could adversely affect reproduction. They could solve the problem of anoestrum in energy deficient cows by feeding additional commercial concentrate mixture.

O'Brien (1972) reported that energy and protein had close functional relation on reproduction and protein was the most important single nutrient affecting reproduction. Roberts (1971) also reported that deficiency of protein and carbohydrate might cause delayed onset of puberty and post-partum anoestrum.

Hewett (1972) observed that both serum protein and serum phosphorus levels had significant correlation with fertility. He also observed a clear tendency for fertility to fall in conjunction with elevated serum protein and serum inorganic phosphorus levels. Sane (1972)observed that the mean serum glucose level of anoestrous cows was only 39.4 mg/100 ml. The problem of anoestrum could be solved by increasing the

serum glucose level to 53 mg/100 ml by feeding additional energy. He postulated that hypoglycemia could depress hypothalamus and in turn reduce the gonadotrophin release from pituitary. Cuenca (1973) and Boyd (1977) also supported this view.

Low energy protein diet would result in late maturity and cessation of oestrous cycle due to lack of ovarian hormones (Maynard and Loosli, 1973; Hafez and Jainudeen, 1974). Downie and Gelman (1976) could solve infertility problem in cattle by correcting the blood glucose level. Sampath and Kumar (1977) reported that inadequate intake of protein and energy, imbalance in their ratio and lack of minerals and vitamin A might cause infertility.

Deshpande et al. (1978) considered the levels of protein and sugar in blood and body weight as very good parameters to identify the infertility problem. The serum protein level and blood glucose level of anoestrous cattle never reached the optimal values viz., 7.9 g/100 ml and 53.35 mg/100 ml respectively. Velhankar (1978) also reported that higher blood glucose levels were required for normal reproductive functions. Deshpande (1979) also observed cessation of oestrous cycle and delayed puberty in cattle as a result of undernutrition.

Deficiency of certain minerals or their imbalances might

affect the breeding efficiency adversely. Perusal of the literature revealed that deficiency of phosphorus and derangement in the ratio between calcium and phosphorus, and between protein and phosphorus were frequently met with in anoestrous cattle. Hignett and Hignett (1951) reported infertility associated with deficiency of phosphorus in cattle. This finding was later supported by Salisbury and Vandemark (1961); Boyd (1970); King (1971); Vujovic et al. (1972); Roberts (1971); Cuenca (1973); Maynard and Loosly (1973); Sattar (1973); Hafez and Jainudeen (1974); Arthur (1975); Morrow (1977); Sampath and Kumar (1977); Scharp (1979); Murtuza et al. (1979); Deas et al. (1979a&b); Neelakantan and Nair (1979) and Samad et al. (1980). Evidences are available to show that anoestrum could be solved and fertility improved by additional phosphorus supplementation in the diet (Morrow, 1970; Dawson, 1970; Sampath and Kumar, 1977; Deshpande and Sane, 1977; Singh et al., 1978; Scharp, 1979; Samad et al., 1980).

Salisbury and Vandemark (1961); Roberts, (1971) and Samad et al. (1980) could find no significant difference between the calcium levels of anoestrous animals and that of normal ones. It was also reported that cattle could reproduce normally with very low levels of calcium. (Salisbury and Vandemark 1961). On the contrary, King (1971) reported reduction in fertility consequent to long and continued

excess or deficiency of calcium and phosphorus.

Ford (1972) reported that excess of calcium or phosphorus could reduce the availability of other minerals like iron and copper, which in turn might reduce fertility. Maynard and Loosli (1973) also reported that when calcium intake was high and with intake of iron and copper in borderline in terms of need, deficiency symptoms of borderline element could occur. According to Sattar (1973) deficiency of calcium, phosphorus and copper could lead to anoestrum and their supplementation could improve fertility.

Hignett and Hignett (1951) observed that a high calcium intake and a low or high phosphorus intake or a wide calcium phosphorus (Ca.P) ratio or a combination of them retarded fertility. Boyd (1970); Sampath and Kumar (1977) and Neelakantan and Nair (1979) also reported that a wide Ca.P ratio would lead to infertility. According to Arora (1977) Ca.P. ratio wider than 2:1 was detrimental to fertility. Samad et al. (1980) also observed that in cows with non-functional ovaries, the serum inorganic phosphorus level was significantly less and Ca.P. ratio was wider

King (1971) reported that a high intake of phosphorus and a narrow Ca.P. ratio improved fertility. Contrary to this, Carsen et al. (1978) had reported that very narrow calcium phosphorus ratio might lead to reproductive problems.

They observed in a herd of infertile cows that the mean serum calcium level and inorganic phosphorus level, were 8.99 and 8.25 mg/100 ml. respectively; the Ca.P. ratio being 1.08:1. After supplementation with steamed bone meal for three months, the serum calcium and serum inorganic phosphorus levels were 10.20 and 6.72 mg/100 ml. respectively, the ratio being 1.53:1. Consequently the infertility problem was solved.

Sane (1972) observed a mean serum calcium level of 8.5 mg/100ml and mean serum inorganic phosphorus level of 5.2 mg/100 ml in a herd of Gir cows with post-partum anoestrum. Hewett (1972) reported a clear tendency for fertility to fall in conjunction with elevated serum phosphous and serum protein levels. He stated that the inorganic phosphorus level in serum would increase consequent to increased intake, but there was no such relation with regard to calcium. King (1971) had fixed optimum values of serum calcium and serum inorganic phosphorus for normal reproductive functions at 9.27 mg/100 ml and 5.42 mg/100 ml respectively whereas Maynard and Loosli, (1973) reported that normal level of serum calcium and serum inorganic phosphorus for normal reproductive functions were 9 to 12 mg/100 ml and four to nine mg/100 ml respectively. Scharp (1979) could reduce the service period of cows in a herd from 109 to 85 days by addition of defluorinated superphosphate to drinking water at

the rate of 2.5 kg/100 litres once weekly. The serum inorganic phosphorus level was also found to increase from 4.5 mg/100 ml to more than 5.8 mg/100 ml.

Sane (1958) observed an acute infertility problem in a herd of Gir cows due to deficiency of copper. The problem could be solved in two month's time by the administration of ten grains copper sulphate daily. Salisbury and Vandemark (1961); Elwishy et al. (1966); Mahadevan and Zubairy (1969); King (1971); Roberts (1971); Sattar (1973); Arthur (1975); Sampath and Kumar (1977); Neelakantan and Nair (1979) and Deas et al. (1979a) also reported infertility problems including anoestrum as a result of copper deficiency. Administration of one g of copper sulphate once in a week was found to be very effective in inducing oestrum in anoestrous buffalo heifers (Elwishy et al.,1966). Mahadevan and Zubairy (1969) observed that inadequate level of copper in animal body caused impairment of reproduction long before other symptoms became apparent. They also reported that administration of 0.5 g copper sulphate daily significantly improved the reproduction performances of cattle. King (1971), Sampath and Kumar (1977) and Hunter (1977) have also concurred with the above view.

Morrow (1970) observed that haemoglobin level of 530 anoestrous cows was below 9.8 g/100 ml while the mean haemoglobin level of 803 cows with normal reproductive performances was 10.6 g/100 ml. Wagner (1972) reported apparent association of anoestrum in dairy cows with haemoglobin levels below 10 g/100 ml, especially in the range 8 to 8.5 g/100 ml. Early breeding occurred in cows with haemoglobin level varying from 10.2 to 10.7 g/100 ml than cows with a mean haemoglobin level of 9.1 g/100 ml (Morrow, 1977).

Perusal of the available literature reveals that several treatments have been tried by various authors in order to combat the problem of anoestrum in cattle. Conflicting reports are available about the efficacy of each.

'Clomiphene', a derivative of Chlorotrianisene, had been grouped as an antiestrogen which inhibits or modifies the action of estrogen (Chemical structure - Fig.1). It was earlier indicated as a contraceptive for both men and women. Later it was found to have a slight estrogenic and a moderate antiestrogenic effect, and in small doses was found to inhibit gonadotrophic function and cessation of estrous cycle. The primary effect noticed in women was an impressive enlargement of ovaries. It later proved to be

a successful agent for inducing ovulation in infertile women by increasing the secretion of pituitary gonadotrophins. It was inferred that 'Clomiphene' interacted with estrogen on the secretion of Follicle Stimulating Hormone Releasing Hormone (FSHRH) and Leutinising Hormone Releasing Hormone (LHRH). Out of the two isomers present, cis-clomiphene was found to possess antiestrogenic action and trans-clomiphene, estrogenic action (Murad and Gilman, 1975).

Roy et al. (1963) opined that the action of clomiphene to release gonadotrophin and cause ovulation was achieved in two ways, one by stimulating the hypothalamo-pituitary axis directly and the other by mitigating the inhibitory effect of estrogen on this axis because of the competitive estrogenic effect of this compound.

Kaivola et al. (1960) obtained by immunological assays evidence of direct effect of 'Clomiphene' on the hypophysis or its superior regulating centres. After initial pituitary suppression it induced an increase in the production of FSH. Roberts (1971) reported that 'Clomiphene' was anti-estrogenic and inhibited release of LH. But he also suggested that further research was necessary.

Perez'-y-Perez' (1972) using 10-12 mg of Clomiphene per sheep induced synchronization of oestrum in a batch of sheep. Oestrus appeared in all sheep treated, but only

70 per cent was ovulatory of which 20 per cent was multiple ovulation and 40 per cent double ovulation. The efficiency of 'Clomiphene' to increase ovulation rate in sheep was investigated by Land (1979). A dose between 10 and 100 microgram per day was found to increase the ovulation rate. He concluded that the effective dose varied according to breed and the stage of breeding season. Dobeljuc et al. (1972) observed that low doses of cis-clomiphene was capable of augmenting LH release induced by administration of LHRH in ovariectomised rats, whereas Trans-clomiphene inhibited LH release.

Moberg (1972) reported that Clomiphene was capable of inducing ovulation in 90.9 per cent of treated mares. High doses caused anovulatory heat but there was no secondary reaction. The conception rate was only 42.4 per cent. Hancock (1973) observed that the conception rate following 'Clomiphene' induced ovulation was very similar to that of spontaneously ovulating population.

Anon (1976) reported that 'Fertivet' brand of 'VP 300' tablets containing 180 mg of trans-clomiphene citrate and 120 mg of cis-clomiphene citrate had action to stimulate hypothalamo-pituitary axis to release GNRH. It appeared to act through stimulation of the secretion of pituitary gonadotrophins, especially LH and inhibition of the regulating effect of estrogens of pituitary.

Deshpande et al. (1976) conducted preliminary trials on the effect of 'Fertivet' tablets in 41 anoestrous cows and 15 buffaloes. At a dose of one tablet daily for five days, it was capable of inducing ovulatory heat in 80 per cent of cows and 100 per cent buffaloes within a period of four to eight days. No adverse effect was noticed. Naikini et al. (1977) opined that 'Fertivet' is a near 'break-through' therapy for tackling the problem of 'true anoestrum' in cattle. They also observed that animals responded better at doses of 300 mg tablet for five days than smaller doses.

Pendse et al. (1977) used 'Fertivet' to treat 5% repeat breeding cows with delayed ovulation. It was observed that, all the cows responded to treatment with ovulation within 24 to 72 hours. The best response was obtained at a dose rate of 450 mg daily for three days which gave 71 per cent of conception. Comparing the effect of 'Fertivet' with various treatments like indigenous, homeopathic and hormonal therapies, Naikini et al. (1978a) observed that 'Fertivet' was very effective in inducing ovulation in 60 per cent of anoestrous cows.

Kodagali et al. (1978) tried 'Fertivet' for inducing ovulation in anoestrous cows with standing follicles. 'Fertivet' was capable of inducing ovulation in all the cows within 80 hours at the dose of 750 mg per cow. Mukory et al. (1979)

administered 'FVT 300' tablets at the rate of one tablet daily for five days to a group of buffaloes in anoestrous condition. Eighty five per cent of the buffaloes came into heat within a period of 11.3 days; of which 80 per cent conceived. The conception rate was more in second service than in the first.

Kodagali (1978) reported that out of 63 anoestrous Cir cows treated with 'Fertivet', 51 (80.95 per cent) came into heat within 12.431 ± 1.922 days after treatment and 38 cows (60.31 per cent) conceived. He concluded that 300 mg on the first two days and 150 mg on third day (750 mg per cow) was significantly more effective than 300 mg for five days (1500 mg per cow).

Manjunath (1979) investigated the effectiveness of 'FVT300' tablets for correcting anoestrum in white cattle recovered from 'foot and mouth' disease. He observed that there was 90 per cent induction of heat and 66.6 per cent conception after administering 'Fertivet' tablets in the normal dose. Better results could be obtained when an injection of 'Tonophosphan' and 'Propalin Forte' was given along with 'Fertivet' when there was 100 per cent ovulatory heat and 80 per cent conception. Contrary to the above findings, Chauhan and Singh (1979) opined that most of the

treatments including 'Fortivet' given to deep anoestrous animals with smooth ovaries had little or no effect at all.

Kodagali et al. (1980) estimated serum LH levels of Gir cows before and after treatment with 'FVT 300' tablets. The mid-cycle LH levels were significantly higher than initial levels in those cows which became pregnant after treatment. They concluded that the serum LH level was not significantly high for induction of oestrum, but for induction of fertile oestrum the level was significantly more than initial levels.

Nathai et al. (1973) found that 'Tonophosphan' (a phosphorus compound) and 'Prepalin forte' (a vitamin A preparation) were effective in hastening post partum oestrum in cows. Singh et al. (1978) also found that 58.8 per cent of anoestrous cows came into heat following five continuous injections of 'Tonophosphan' and 'Prepalin forte'. It was also observed that 59.9 per cent of the remaining cows also responded to three more injections.

'Super-mindif' a mineral mixture was used as a treatment for anoestrum by Porwal et al. (1976). It was observed that 53.35 per cent of the cows came into heat and out of which 87.5 per cent had conceived. Sampath and Kumar (1977) also

observed that feeding of mineral mixture for one month solved the problem of anoestrum.

Hays and Carlevaro (1959) and Grigoriv et al. (1978) reported that electrical stimulation of the cervix induced oestrum in anoestrous cows within few days after treatment. Ermaeenkov (1964) massaged the uterus and ovaries of anoestrus cows twice daily for three days and reported that 22.7 per cent of cows had ovulatory heat after four days. Hintnaus (1965) massaged the clitoris of 32 cows seven minutes daily for six consecutive days and reported that utero-ovarian massage and application of Tincture iodine into cervix induced oestrum in 46.66 per cent anoestrous cows, out of which 92.85 per cent conceived. But Araujo et al. (1973) could not find any effect for ovarian massage.

Ermaeenkov (1964) claimed that lavage of cervix with two per cent Lugol's iodine and insemination at the cervix with one ml of semen twice daily at 3 days interval was helpful to induce oestrum in cows. Porwal et al. (1976) obtained 43.33 per cent of induction of oestrum and 92 per cent conception by the application of Lugol's iodine at the cervix for eight days. Deshpande and Sane (1977) also used intra-uterine administration of Lugol's iodine to induce ovulation in anoestrous cows. But Chauhan and Singh (1979) found

intrauterine administration of 50-150 ml of 0.5 per cent Lugol's iodine not useful in inducing oestrum. Deas et al. (1979a) reported that uterine irrigation with Lugol's iodine in a dilution of 1:500 might stimulate initiation of oestrus cycle. However, Arthur (1975) cautioned that eventhough intrauterine Lugol's iodine therapy might induce oestrum, introduction of uterine catheter fo heifers would be difficult and sometimes it might even cause puncture of uterus.

Various ayurvedic drugs have also been used to treat anoestrous cows. Rao and Murthy (1971b) claimed that 'Prajana' an ayurvedic drug was very effective in anoestrous condition and reported that 84.78 per cent of treated cows exhibited oestrum and 72.72 per cent conceived on subsequent inseminations. Porwal et al. (1976) also reported favourable results using 'Prajana'. Deshpande and Sane (1977) tried ayurvedic drugs like 'Prajana', 'Heatrone' and 'Samudrapala' and 'Aloes compound' and reported that 'Prajana' and 'Heatrone' had given promising results. On the contrary, Kaikini et al. (1978a) observed that ayurvedic drugs like 'Samudrapala', 'Guggul', 'Palerpapda seeds', Heatrone' and homoepathic drugs like 'Graphitis' were of no value in inducing oestrum in anoestrous cows.

Many hormonal preparations have been tried to tackle the problem of anoestrum in cattle, but the results are conflicting. Arthur (1975) stated that hormonal treatment for anoestrum is valueless. Jainudeen (1978) also questioned the value of hormonal treatment to stimulate ovarian activity. Kaikini et al. (1978b) felt that in the absence of information regarding circulating hormones, treating anoestrous cows with hormone preparations is amounting to shooting in the dark, and expected results are not likely to come up.

Frangulgan (1943) and Arbeiter (1972) reported that oestrogen preparations were effective in inducing ovulation in non functional ovaries. Araujo et al. (1973) induced oestrum in anoestrous cows by injecting 20 mg of oestrogen. Favourable results by using oestrogen in anoestrous cows was also reported by Dindorkar and Kohli (1973). Patil and Khan (1978) treated 760 anoestrous cattle with 'Clinestrol' (a synthetic oestrogen preparation by Glaxo laboratories) and reported favourable results. No adverse reactions was noticed. On the contrary Reece (1969) could not find any effect for oestrogen to induce oestrum in anoestrous animals. Roberts (1971) also could not find any physiological basis for oestrogen treatment for anoestrum. He also cautioned about the complications like ovarian cysts as a

result of oestrogen therapy. However, Arthur (1975) observed that 'Stilboestrol' caused anovulatory heats but failed to initiate the cycle. Jainudeen (1978) also justified the above finding. Similarly Tripathy et al. (1979) opined that eventhough it might be possible to induce oestrum by small doses of oestrogen, the occurrence of ovulation and restoration of normal pattern of oestrum cycle could not be guaranteed. Doss et al. (1979a) questioned the efficacy of 'Stilboestrol' for treatment of anoestrum.

Arbeiter (1972) obtained satisfactory results in treatment of bovine anoestrum by using progestagens, either alone or in combination with oestrogens. Schimidt et al. (1973) also reported considerable reduction in the post partum anoestrum period in bovines by oral administration of 6-chloro-6-dihydro-17-acetoxy progesterone (CAP) (a synthatic progestagen). Mia and Rehman (1974) observed that all the cows administered with 25 mg progesterone daily for ten days exhibited oestrum within 18 days. Janakiraman et al. (1975) administered MGA (Melengestrol acetate, a synthatic gestagen) one mg in two ml pea nut oil orally for 14 days to 140 buffaloes having irregular breeding, and reported that within three to seven days, 97 buffaloes exhibited oestrum. Anand and Madan (1976) also reported promising results with MGA in anoestrous cattle.

Drew et al. (1978), Roche et al. (1978) and Sulman et al. (1978) successfully induced ovulatory heat in cows having functionless ovaries by administration of PRID (Progesterone Releasing Intravaginal Device). But the conception rate in the induced oestrum was not satisfactory. Deshpande and Sane, (1977) used progestron and combination of oestrogen and progestron parenterally for anoestrous cows. It was observed that 70 per cent of the animals exhibited oestrum within three to four days after treatment.

Mathai et al. (1971) observed that injection of 50 units of oxytocin within six hours after calving was effective to hasten the onset of post-partum heat in cows.

Scham et al. (1972) observed that LHRH and FSHRH were not effective in inducing ovulation in anoestrous cows. But Zolday and Szanci (1975) reported 84.8 per cent induction of oestrum and 45.6 per cent of conception by administering 5 ml of 'Lutal', a synthatic gonadotrophin releasing hormone (GnRH). Munke and Zuber (1977) used a new LHRH analogue 'HOE 766' to treat acyclic cows and found that 105 out of 156 cows treated exhibited oestrum and 93.7 per cent conceived.

Araujo et al. (1943) could not observe any significant effect from treatment of anoestrous cows with pregnant mare's serum (PMS) or human chorionic gonadotrophin (HCG). Arthur (1975)

stated, eventhough gonadotrophin was theoratically indicated, practically it might cause super follicle production with heat but it might not induce ovulation and the animal might then relapse into anoestrous state. But Franjuljan (1943) reported that intramuscular injection of blood of pregnant mares induced heat in 70 per cent of anoestrous animals. He also reported that pregnant cow's blood was equally effective. Reece,(1969) observed that 100 iu of PMS induced oestrum in 21 out of 46 anoestrous cows but cautioned that even slight excess stimulation might result in either super ovulation or cyst formation in ovaries. Deas et al. (1979a) could induce ovulation by administration of 1500 to 2000 iu pregnant mare's serum gonadotrophin (PMSG) to anoestrous animals but they also cautioned about the probable chance of multiple ovulation.

MATERIAL AND METHODS

MATERIAL AND METHODS

The present study was conducted in three sections.

(i) Investigation on the incidence and nature of anoestrum among crossbred cattle in Kerala.

(ii) Investigation on the probable etiological factors for 'true anoestrum' among crossbred cattle.

(iii) Trials with suitable corrective measures for 'true anoestrum' among crossbred cattle.

(i) Investigation on the incidence and nature of anoestrum among crossbred cattle in Kerala.

One hundred and eighty four crossbred cows maintained in the University livestock Farm, Mannuthy; 76 crossbred heifers above the age of 18 months maintained in the Cattle Breeding Farm, Thumurmuzhy and 401 crossbred cows and heifers presented at the various 'anti-sterility' camps at different places formed the material for the study.

The breeding history of all animals selected were collected and analysed. Cows which failed to exhibit oestrus even after 90 days of calving, heifers which failed to exhibit oestrus even after attainment of 18 months of age, and cows and heifers which failed to exhibit oestrum even after 60 days from a service but which were not pregnant were identified as 'anoestrous' (Roberts, 1971; Arthur, 1975).

The animals identified to be anoestrous were subjected to detailed gynaeco-clinical examination as per Zemjanis (1970). The reproductive organs were examined in detail, at least thrice at eight days interval to detect any cyclical changes. In case of animals presented at the antisterility camps, repeated examinations, were not possible in all cases.

Those anoestrous animals which were found to have smooth and inactive ovaries without any palpable structures, atonic or flaccid uterus, constricted cervix and a pale vaginal mucous membrane during the three consecutive examinations were grouped as in 'true anoestrum' as per Arthur (1975) and Deas et al. (1979b).

Those cows and heifers which were having either corpus luteum or follicle in any of their ovaries which were found to undergo cyclical changes, but without any external manifestations of heat were grouped as 'anoestrous' due to silent heat (Zemjanis, 1970; Roberts, 1971 and Arthur, 1975) Those animals which were found to be pregnant, or were actually in heat or having any apparent pathological conditions were grouped as such.

The cows and heifers identified to be in 'true anoestrum' were marked separately for further study.

(ii) Investigations on the possible etiological factors for 'true anoestrum' among crossbred cattle.

Forty five crossbred cows and 64 crossbred heifers marked to be in 'true anoestrum' were used for the study. They were apparently healthy and free from any systemic diseases. Animals having congenital abnormalities like ovarian hypoplasia, and pathological conditions like cystic ovaries were excluded.

The detailed breeding history and information regarding management were collected. Blood samples were collected from all animals for biochemical analysis. About two ml of blood was collected into a test tube into which a pinch of sodium citrate was added as anticoagulant. Haemoglobin was estimated by cyanmethaemoglobin method (Benjamin, 1974) using an Erma Hemophotometer. A haemoglobin level below 8 g/dl was considered sub-normal (Maynard and Loosli, 1973).

About 20 ml of blood was collected into a test tube and allowed to clot. It was then centrifuged at a temperature of 4°C in a refrigerated centrifuge and the serum was collected in labelled test tubes and kept under refrigeration for biochemical estimations.

Serum calcium was estimated by the Clark and Collip modification (1925) of Kramer-Tisdall method (1921). Inorganic phosphorus in serum was estimated as per Fiske and Subbarow (1925). Animals showing serum calcium level less than 8 mg/100 ml and serum inorganic phosphorus level less than 4 mg/100 ml were considered to be deficient (Maynard and Loosli, 1973). The Ca.P. ratio was calculated and a ratio wider than 2:1 or narrower than 1:1 was considered to be imbalance (Arora, 1977).

Diethyl Dithiocarbomate method (Eden and Green,1940 and Ventura and King,1951) as described by Varley (1975) was used for estimation of serum copper and a value less than 100 microgrammes per 100 ml was considered to be subnormal (Maynard and Loosli, 1973). Serum glucose was estimated by O-Toludin method of Hultman (1959) modified by Dubowski (1962) and Hyravinen and Nikkila (1962) and total protein in serum by Biuret method (Gornall et al., 1949) Glucose value less than 45 mg/dl and total protein value less than 6g/dl were considered as deficient (Blood et al.(1979).

(iii) Trial with suitable corrective measures for 'true anoestrum' among crossbred cattle:

Cows and heifers found to be having normal blood levels of calcium, inorganic phosphorus, haemoglobin, copper, protein

and glucose and a Ca.P. ratio within the normal limits were used for trial with 'Fertivet'*. Fifteen cows and 19 heifers were treated with 'Fertivet' while nine cows and 10 heifers were kept as control.

The cows and heifers in the treated group were administered orally with one tablet of 'Fertivet' per day for five days. Administration consisted of 125 ml of one per cent copper sulphate solution followed by one pulverized tablet dissolved in 300 ml of water daily for five days. If heat symptoms were observed during the course of treatment, further medication was stopped. The control animals were given only 125 ml of one per cent copper sulphate solution daily for five days.

After the commencement of treatment both experimental and control animals were kept under observation for manifestation of oestrum. The detection of oestrum was conducted by close observation, repeated examinations and microscopical observations of cervical mucous for typical crystallization pattern. Artificial insemination was

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*'Fertivet'FVT 300' is a product of Ar-Ex laboratories, Bombay containing 180 mg of Cis-Clomiphene and 120 mg Trans-Clomiphene citrate per tablet (Anon, 1976).

conducted to all the animals which exhibited pronounced heat with well developed follicle. The animals were under rigid sexual health control. A positive response to treatment was considered to be induction of a prominent heat with well developed follicle within 45 days from the start of treatment. Those animals which had shown positive response were checked again after 12 days for presence of well developed corpusluteum. Pregnancy diagnosis was done by rectal palpation after 35 to 45 days. Oestrus induction interval in days was calculated from the commencement of treatment.

Cows and heifers which had shown subnormal levels of calcium, inorganic phosphorus, haemoglobin, copper, protein or glucose or showing any imbalance between calcium and phosphorus were used for trial with 'Fortimin'* brand of mineral mixture.

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*'Fortimin' is a mineral mixture marketed by M/s. Cheeran & Co., Trichur. It had been formulated specially to improve the reproductive performances (Anon, 1979). It is reported to contain:

Calcium	21.00%	Magnesium	0.41%
Phosphorus	14.00%	Sulphur	0.20%
Cobalt	0.09%	Manganese	0.04%
Copper	0.56%	Zinc	0.002%
Iron	6.35%	Molybdenum	0.0004
Vitamin A	15000 IU	Vitamin D	1500 IU

Twelve cows and 23 heifers were given 30 g of Fertimin daily for one month and nine cows and 12 heifers were kept as control. The powder was mixed with about 100 g molasses or jaggary and 25 to 30 g of sodium chloride and was administered orally as an electuary to the experimental animals. The animals were subjected to regular gynaeco-clinical examination. Detection of oestrum was conducted by close observation, repeated examination and microscopical examination of cervical mucuous for typical crystallization pattern. Cows which exhibited oestrum were inseminated after confirming the ovarian activity. Induction of a prominent oestrum with well developed follicle within 45 days after the end of treatment was considered to be a positive response. These animals were checked again after 12 days for presence of corpus luteum. Pregnancy was confirmed after 35 to 45 days.

The data were collected, tabulated and arranged according to Snedecar and Cochran (1976).

RESULTS

RESULTS

A detailed investigation was undertaken on the incidence and etiology of 'true anoestrum' among crossbred cattle in the State, and efforts were made to evolve suitable corrective measures for the same. A total of 184 crossbred cows and 76 crossbred heifers above 18 months of age in the livestock farms attached to the Kerala Agricultural University and 401 crossbred cattle presented for treatment at various antisterility camps formed the material for the study. The results of the investigation are presented in table I to VIII and represented graphically in figures 2 to 5.

The results of the investigations on the incidence of 'true anoestrum' among the crossbred cattle in the livestock farms attached to the University are presented in table I. It could be seen that out of 184 cows, 52 (28.3 per cent) were anoestrous, but detailed and repeated examinations revealed that only 32 (17.4 per cent) were in 'true anoestrum' and 15 (8.2 per cent) were cycling. Four cows were detected to be in silent heat at the time of examination, and one had cysts in both the ovaries. Similarly among heifers, 22 (28.94 per cent) were apparently anoestrous but on detailed examination only 17 (22.36 per cent) were in true anoestrum and

three (3.94 per cent) were cycling. Bilateral hypoplasia of ovaries and cystic condition of the ovaries were detected in one (1.31 per cent) heifer each.

The results of the observations on cows and heifers presented at the infertility camps are shown in table II. It is evident from the table that 200 (49.88 per cent) out of 401 cases brought for treatment were reportedly anoestrous, out of which 18 (4.4 per cent) were normal; 11 (2.7 per cent) pregnant and 7 (1.7 per cent) in heat. It may also be observed that 31 (7.7 per cent) cases were found to be cycling as evidenced by palpable corpus luteum in one of the ovaries. True anoestrum was noticed only in 113 animals (28.2 per cent), while the genital organs were underdeveloped in 36 (9 per cent) cases. Bilateral ovarian hypoplasia was noticed in one heifer (0.2 per cent) and bilateral cystic ovary in another case.

The heifers and cows detected to be in true anoestrum had smooth and inactive ovaries with no indication of cyclical activity. The uterus was atonic and cervix tightly closed. The vaginal mucous membrane was pale and there was no visible discharge. The ovarian, uterine and vaginal pictures had shown no change in consecutive examinations also.

Analysis of blood for serum calcium, serum inorganic phosphorus, haemoglobin, serum copper, serum protein and serum glucose of 64 crossbred heifers and 45 crossbred cows in true anoestrum revealed that anoestrum in case of 24 cows and 29 heifers were not due to nutritional causes, as they had shown normal levels of calcium, phosphorus, haemoglobin, copper, protein and glucose. The Ca.P. ratio was between one and two.

Perusal of the data on tables III and IV reveal that the anoestrum in case of 21 cows and 35 heifers was due to nutritional factors. The serum calcium levels of these animals were well within the normal range (mean 10.69 mg/dl and 10.15 mg/dl respectively), while the mean serum inorganic phosphorus level was comparitively low (4.05 and 4.12 mg/dl respectively). Four cows and 13 heifers had serum inorganic phosphorus level below 4 mg/dl. The Ca.P ratio was very wide the mean being 2.69 and 2.46 for the heifers and cows respectively. It could also be seen that the mean haemoglobin level of 35 heifers and 21 cows were 9.16 g/dl and 9.7 g/dl respectively. There was not much variation in the serum copper level (91.07µg/dl and 88.32µg/dl respectively). The levels of serum protein and serum glucose in case of 35 heifers were 6.54 g/dl and 48.49 mg/dl and in case of 21 cows, 6.83 g/dl and 51.6 mg/dl respectively.

The results of treatment with 'Fertivet FVT 300' for cows and heifers are shown in table V and VI and represented graphically in figures 2 and 3. It could be seen that all the 15 cows treated with 'Fertivet' exhibited ovulatory oestrum within a mean period of 5.73 days (100 per cent), while only three out of nine in the control group came in heat (33.33 per cent) within a mean period of 23 days. The difference between two groups was highly significant. Among the treated cows, 10 (66.67 per cent) conceived, while only one from the control group became pregnant (11.1 per cent), the difference being significant at five per cent level.

It could also be observed that out of 19 heifers treated with Fertivet, 17 (89.47 per cent) came into heat within a mean period of 5.47 days, while only three from the control exhibited oestrum (30 per cent). The difference was observed to be highly significant. The induced heat was confirmed to be ovulatory by rectal palpation. Eight heifers (42.11 per cent) from the treated group conceived while none from the control group became pregnant. The difference was significant at five per cent level.

The results obtained from trial with 'Fertimin' brand of mineral mixture are tabulated in table VII and VIII and represented in figures 4 and 5. Perusal of the table VII will reveal that out of 12 cows treated, 11 (91.67 per cent)

showed ovulatory heat within an average period of 30.0 days, while in the control group only one (11.1) per cent) exhibited oestrum. The difference was found to be highly significant. Six cows in the treated group (50 per cent) became pregnant, while none of the control conceived. The difference was also found to be significant at five per cent level.

It could be seen from table VIII that among the heifers, 18 in the treated group (70.26 per cent) and three in the control group (25 per cent) exhibited ovulatory oestrum. The difference between the two groups was found to be highly significant. The average interval for the induction of oestrum was 27.77 days in the treated group and 25 days in the control. Ten heifers in the treated group (43.48 per cent) conceived while there was no pregnancy among control animals. The variation was significant at five per cent level.

TABLES

Table 1. Incidence of anoestrum among crossbred cattle maintained in the livestock farms attached to the Kerala Agricultural University.

Sl. No.	Name of farm	Total number in the herd.	Number of animals in anoestrum	Apparently anoestrous				
				True anoestrum	Cycling	In heat	Congenital condition.	Cystic ovary.
1.	University livestock farm, Mannuthy (cows)	184	52 (28.3)	32 (17.4)	15 (8.2)	4 (2.2)	-	1 (0.5)
2.	Cattle breeding farm, Thumburmuzhy. (Heifers above 18 months)	76	22 (28.9)	17 (22.4)	3 (3.9)	-	1 (1.3)	1 (1.3)

N.B. Figures in parenthesis indicates percentage.

Table I. Incidence of anoestrum among crossbred cattle presented for treatment at various antisterility camps.

Number of sterility camps attended.	Total number of crossbred cattle presented for treatment.	Reported to be anoestrous (Number 2)	Reported to be anoestrous						
			True anoestrum	Preg-nant.	Cycl-ing	In heat	Under developed genitalia	Congen-ital condition	Cystic ovary.
8	401	200 (49.9)	113 (28.2)	11 (2.7)	31 (7.7)	7 (1.7)	36 (9.0)	1 (0.2)	1 (0.2)

N.B. Figures in parenthesis indicates percentage

Table III. Blood analysis of crossbred heifers in true anoestrum

Sl. No.	Name or Number	Serum Calcium mg/dl	Serum inorganic phosphorus mg/dl	Ca/P.	Haemo-globin g/dl	Serum copper µg/dl	Serum protein g/dl	Serum glucose mg/dl
1	2	3	4	5	6	7	8	9
1	005	10.0	4.16	2.40	10.2	86.25	8.4	49.9
2	370	10.4	3.84	2.60	9.8	110.62	5.3	50.0
3	520	10.0	3.25	3.06	9.5	83.5	6.8	42.0
4	43	9. 8	4.26	2.30	8.9	78.2	6.8	48.0
5	833	10.2	3.96	2.58	8.4	87.1	6.1	44.0
6	382	10.4	3.26	3.19	8.2	92.4	5.68	48.5
7	842	10.6	3.92	2.70	8.0	-	6.58	42.0
8	760	10.9	4.03	2.70	11.8	98.7	5.68	48.95
9	735	10.2	3.84	2.66	11.8	100.3	6.85	55.0
10	836	10.4	4.28	2.43	10.1	84.5	5.2	47.2
11	860	9.6	4.4	2.18	9.8	87.5	5.6	48.2
12	850	10.6	4.24	2.5	8.2	94.6	6.5	49.0

(Contd...)

Table III (Contn.) Blood analysis of crossbred heifers in true anoestrum

Sl. No.	Name or Number	Serum Calcium mg/dl	Serum inorganic phosphorus mg/dl	Ca/P.	Haemo-globin g/dl	Serum copper µg/dl	Serum protein g/dl	Serum glucose mg/dl
1	2	3	4	5	6	7	8	9
13	851	9.8	3.81	2.57	8.0	88.4	6.3	51.0
14	832	10.6	4.12	2.57	9.5	89.4	6.5	49.5
15	Omana	10.0	4.3	2.33	8.8	86.1	7.0	51.0
16	Nandini	10.6	3.8	2.79	7.5	80.4	6.7	49.0
17	MH 17	11.8	4.1	2.88	8.8	115.06	7.2	-
18	MH 18	11.6	4.4	2.64	9.1	97.44	6.25	-
19	MH 19	11.1	4.2	2.64	9.2	-	7.03	-
20	MH 20	12.0	4.4	2.73	9.8	120.96	6.5	-
21	MH 21	10.0	3.6	2.78	8.8	91.47	7.03	
22	MH 22	11.4	4.2	2.71	7.4	77.07	6.5	
23	MH 23	11.8	4.4	2.68	8.5	103.0	6.45	
24	523	11.4	3.8	3.00	11.2	87.3	6.36	

(Contd..)

Table III. Blood analysis of crossbred heifers in true anoestrum (Contn.)

Sl. No.	Name or Number	Serum calcium mg/dl	Serum inorganic phosphorus mg/dl	Ca/P	Haemo-globin g/dl	Serum copper µg/dl	Serum protein g/dl	Serum glucose mg/dl
1	2	3	4	5	6	7	8	9
25	791	10.4	3.6	2.89	10.8	79.5	5.38	
26	MIC 3	11.8	4.3	2.74	8.0	110.96	6.5	
27	MIC 4	11.4	4.4	2.59	8.0	89.7	6.45	
28	MIC 5	11.6	3.8	3.05	9.4	86.66	6.5	
29	MIC 6	12.4	4.4	2.82	9.8	77.6	7.03	
30	MIC 7	11.8	4.4	2.68	8.9	87.4	6.5	
31	MIC 8	11.0	3.8	2.89	7.8	88.5	7.0	
32	MIC 9	11.4	4.1	2.78	8.5	78.4	6.95	
33	MIC10	11.8	4.0	2.95	8.95	77.4	7.10	
34	MIC11	11.0	4.4	2.50	9.45	85.4	7.60	
35	702	11.4	4.1	2.78	9.8	95.4	7.0	51.0
MEAN		10.89	4.05	2.69	9.16	91.07	6.54	49.49

Table IV. Blood analysis of crossbred cows in true ancestrum

Sl. No.	Name or Number	Serum calcium mg/dl	Serum inorganic phosphorus mg/dl	Ca/P	Haemo-globin g/dl	Serum copper µg/dl	Serum protein g/dl	Serum glucose mg/dl
1	2	3	4	5	6	7	8	9
1	001	10.8	4.04	2.67	9.6	83.51	7.21	51
2	724	9.4	4.1	2.29	9.6	87.5	6.0	52.5
3	628	9.4	4.18	2.25	8.0	70.3	6.64	43.7
4	24159	9.8	4.21	2.33	10 4	83.6	8.56	56.0
5	431	10.4	4.12	2.52	9.0	83.46	8.1	54.0
6	733	10.0	4.26	2.35	10.8	88.45	6.25	-
7	A 640	10.6	4.4	2.41	9.4	83.5	5.2	56.2
8	476	9.8	4.18	2.34	11.0	86.2	6.5	55.0
9	624	9.8	4.16	2.36	9.0	85.3	8.1	47.5
10	683	10.2	4.1	2.49	8.8	79.9	7.0	55.0
11	577	10.0	4.27	2.34	12.0	87.9	7.9	55.0

(Contd...)

Table IV. Blood analysis of crossbred cows in true anoestrum (Contn.)

Sl. No.	Name or Number	Serum Calcium mg/dl	Serum inorganic phosphorus mg/dl	Ca/P	Haemo-globin g/dl	Serum copper µg/dl	Serum protein g/dl	Serum glucose mg/dl
1	2	3	4	5	6	7	8	9
12	615	11.0	4.2	2.62	8.4	93.2	6.7	47.0
13	A 649	10.2	4.1	2.49	9.4	79.7	6.46	52.5
14	640	9.8	3.8	2.58	7.8	82.3	8.10	56.0
15	T 661	10.4	3.9	2.67	9.6	97.6	5.2	47.5
16	A 681	11.0	4.17	2.64	9.0	78.3	5.85	54.0
17	MCC 5	10.6	4.2	2.52	10.2	96.2	7.61	44.8
18	MCC 6	9.6	3.8	2.53	10.4	91.3	7.81	49.6
19	MCC 7	10.4	3.8	2.74	9.9	100.2	6.5	50.6
20	MCC 8	9.8	4.4	2.23	10.2	97.9	6.7	49.8
21	MCC 9	10.2	4.1	2.49	10.4	95.4	6.0	48.5
MEAN		10.15	4.12	2.46	9.7	88.32	6.83	51.60

Table V. Trials with 'Fertivet' - Experimental.
(Cows)

Sl. No.	Name or Number	Parity	Type of anoestrum	Period of anoestrum (days)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5	6	7
1	666	C_1	Post service	150	3	Positive
2	616	C_2	Post partum	192	3	Positive
3	10286	C_2	Post service	240	21	Positive
4	512	C_2	Post partum	110	7	Positive
5	558	C_2	Post partum	180	6	Positive
6	30	C_1	Post partum	150	8	Positive
7	671	C_1	Post service	360	4	Negative
8	35	C_1	Post partum	210	3	Negative

(Contd..)

Table V. Trials with 'Tertivet' - Experimental.
(Cows)

Sl. No.	Name or Number	Parity	Type of anoestrum	Period of anoestrum (days)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5	6	7
9	537	C_4	Post service	240	3	Negative
10	37	C_1	Post partum	180	4	Negative
11	T 626	C_1	Post partum	210	4	Negative
12	Karampi	C_1	Post partum	270	6	Positive
13	Mini	C_1	Post partum	365	6	Positive
14	IC 14	C_3	Post partum	330	3	Positive
15	IC 15	C_2	Post partum	180	5	Positive

(Table V contd..)

Table V. Trials with 'Fertivet' - Summary
(Cows)

Sl. No.		Treated	Control	Statistical profile x^2	Significance
1	Total number	15	9		
2	Number in which heat induced	15	3	10.02	**
3	Interval from commencement of treatment to oestrum (mean) in days	5.73	23.7		
4	Number pregnant	10	1	4.93	*

* Significant at 5% level
** Significant at 1% level

(Table V Concl.)

Table VI. Trials with 'Pertivet' - Experimental.
(Heifers)

Sl. No.	Name or Number	Age (months)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5
1	697	30	4	Negative
2	Arruny	46	5	Pregnant
3	Dharmada	48	3	Negative
4	Nandini	44	3	Negative
5	1210	35	No response	-
6	17180	24	20	Negative
7	M 7	36	3	Pregnant
8	34623	34	3	Negative
9	1184	42	4	Pregnant

(Contd..)

Table VI. Trials with 'Tertivet' - Experimental.
(Heifers)

Sl. No.	Name or Number	Age (months)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5
10	20870	55	5	Negative
11	14486	48	5	Pregnant
12	TH 12	30	3	Negative
13	675	30	4	Negative
14	TH 14	36	No response	-
15	TH 15	36	16	Pregnant
16	TH 16	35	4	Pregnant
17	TH 17	30	4	Pregnant
18	TH 18	32	4	Pregnant
19	TH 19	36	3	Pregnant

(Table VI contd.)

Table VI. Trials with 'Fertivet' - Control
(Heifers)

Sl. No.	Name or Number	Age (months)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5
1	FHC-1	48	No response	-
2	FHC-2	36	No response	-
3	FHC-3	35	31	Negative
4	FHC-4	46	No response	-
5	FHC-5	30	No response	-
6	FHC-6	26	35	Negative
7	FHC-7	30	16	Negative
8	FHC-8	30	No response	-
9	FHC-9	36	No response	-
10	FHC10	36	No response	-

(Table VI. contd.)

Table VI. Trials with 'Fertivet' - Summary.
(Heifers)

Sl. No.		Treated	Control	Statistical profile X^2	Significance
1	Total number	19	10		
2	Number in which heat induced	17	3	8.23	**
3	Interval from commencement of treatment to oestrum (mean)	9.47	27.33		
4	Number pregnant	8	Nil	3.90	*

* Significant at 5% level.

** Significant at 1% level.

(Table VI Concl.)

Table VII. Trials with 'Fertimin' - Experimental.
(Cows)

Sl. No.	Name or Number	Parity	Type of anoestrum	Period of anoestrum (days)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5	6	7
1	001	C_6	Post service	115	55	Negative
2	724	C_1	Post partum	105	40	Positive
3	628	C_1	Post partum	260	46	Positive
4	26159	C_2	Post partum	125	40	Negative
5	431	C_2	Post partum	125	37	Positive
6	733	C_1	Post partum	126	34	Positive
7	A 640	C_1	Post partum	260	37	Negative
8	476	C_2	Post service	370	No response	-
9	624	C_2	Post service	100	33	Negative
10	683	C_1	Post service	120	50	Negative
11	577	C_2	Post partum	165	35	Positive
12	615	C_3	Post partum	125	20	Positive

(Table VII contd..)

Table VII. Trials with 'Fertimin' - Summary.
(Cows)

Sl. No.		Treated	Control	Statistical profile x^2	Significance
1	Total number	12	9		
2	Number in which heat induced	11	1	10.54	**
3	Mean interval from commencement of treatment to heat (days)	38.8	28		
4	Number pregnant	6	Nil	4.09	*

* Significant at 5% level.

** Significant at 1% level.

(Table VII concl.)

Table VII. Trials with 'Fertimin' - Control.
(Cows)

Sl. No.	Name or Number	Parity	Type of anoestrum	Period of anoestrum (days)	Interval from the commencement of treatment to oestrum (days)	Result of A.I.
1	2	3	4	5	6	7
1	A 649	C_1	Post partum	360	No response	-
2	640	C_3	Post partum	99	No response	-
3	T 661	C_3	Post partum	90	No response	-
4	NCC 4	C_1	Post service	150	No response	-
5	A 681	C_1	Post partum	110	No response	-
6	NCC 6	C_2	Post service	140	28	Negative
7	NCC 7	C_3	Post partum	180	No response	-
8	NCC 8	C_2	Post service	110	No response	-
9	NCC 9	C_4	Post partum	145	No response	-

(Table VII contd.)

Table VIII. Trials with 'Fertimin' - Experimental.
(Heifers)

Sl. No.	Name or Number	Age (months)	Interval from the commencement of treatment to heat (days)	Result of A.I.
1	2	3	4	5
1	005	24	28	Negative
2	370	20	44	Negative
3	520	30	24	Positive
4	766	24	30	Negative
5	43	20	43	Negative
6	833	21	26	Negative
7	382	21	No response	Negative
8	842	18	No response	Negative
9	735	27	20	Positive
10	836	21	31	Positive
11	868	19	31	Positive
12	850	20	20	Positive

(Contd.)

Table VIII. Trials with 'Fertimin' - Experimental.
(Heifers)

Sl. No.	Name or Number	Age (months)	Interval from the commencement of treatment to heat (days)	Result of A.I.
1	2	3	4	5
13	851	20	20	Positive
14	837	26	16	Positive
15	Lalana	30	31	Positive
16	Nandini	24	35	Positive
17	[illegible] 17	42	40	Positive
18	[illegible] 18	30	15	Negative
19	[illegible] 19	36	No response	-
20	[illegible] 20	36	18	Negative
21	[illegible] 21	34	28	Negative
22	[illegible] 22	28	No response	-
23	[illegible] 23	31	No response	-

(Table VIII contd.)

Table VIII. Trials with 'Pertimin' - Control
(Heifers)

Sl. No.	Name or Number	Age (months)	Ineterval from the commencement of trial to heat (days)	Result of A.I.
1	2	3	4	5
1	523	29	No response	-
2	791	21	No response	-
3	[illegible] 3	42	No response	-
4	[illegible] 4	30	45	Negative
5	[illegible] 5	36	No response	-
6	[illegible] 6	48	No response	-
7	[illegible] 7	42	No response	-
8	[illegible] 8	36	17	Negative
9	[illegible] 9	21	No response	-
10	[illegible]10	36	No response	-
11	[illegible]11	30	No response	-
12	[illegible]12	24	No response	-

(Table VIII. Contd.)

Table VIII. Trials with 'Fertimin' - Summary.
(Heifers)

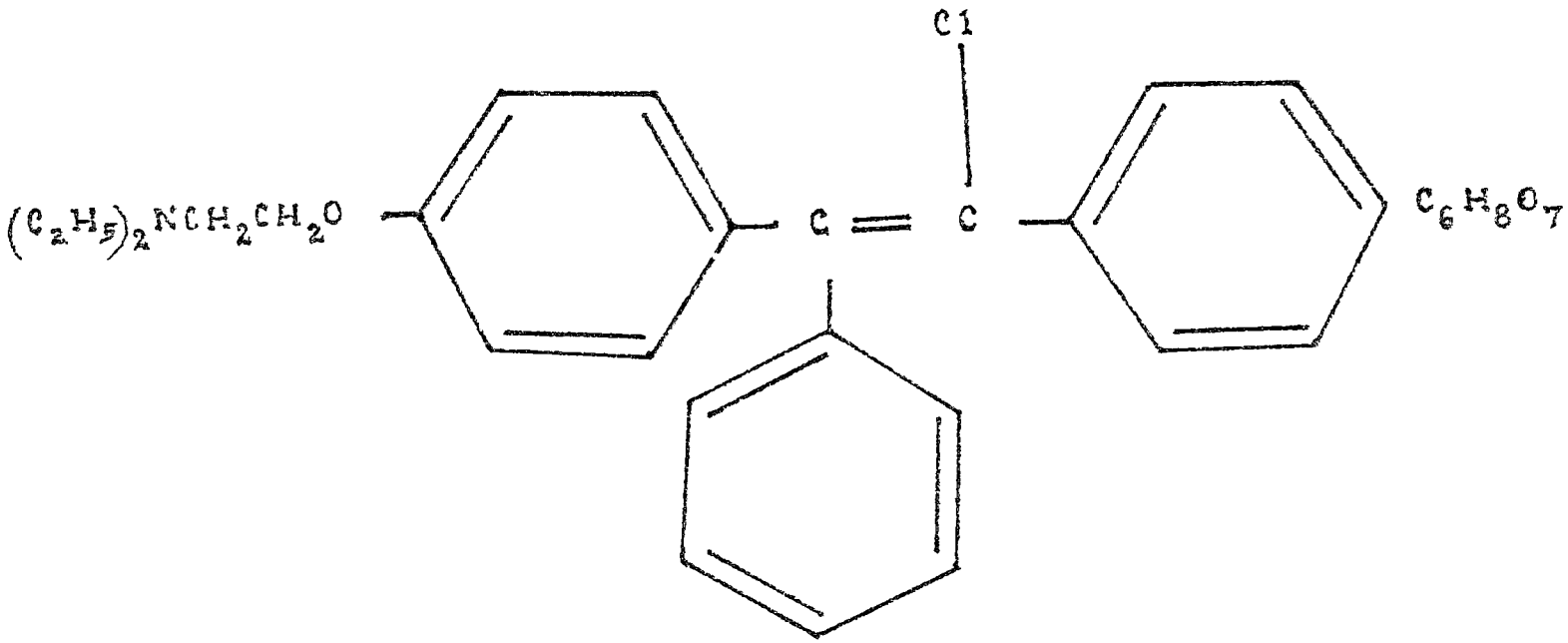
Sl. No.		Treated	Control	Statistical profile X^2	Significance
1	Total number	23	12		
2	Number in which heat was induced	19	3	7.23	**
3	Mean interval from commencement of treatment to heat (days)	27.77	30.67		
4	Number pregnant	10	Nil	5.33	*

* Significant at 1% level.

** Significant at 5% level.

(Table VIII. Concl.)

ILLUSTRATIONS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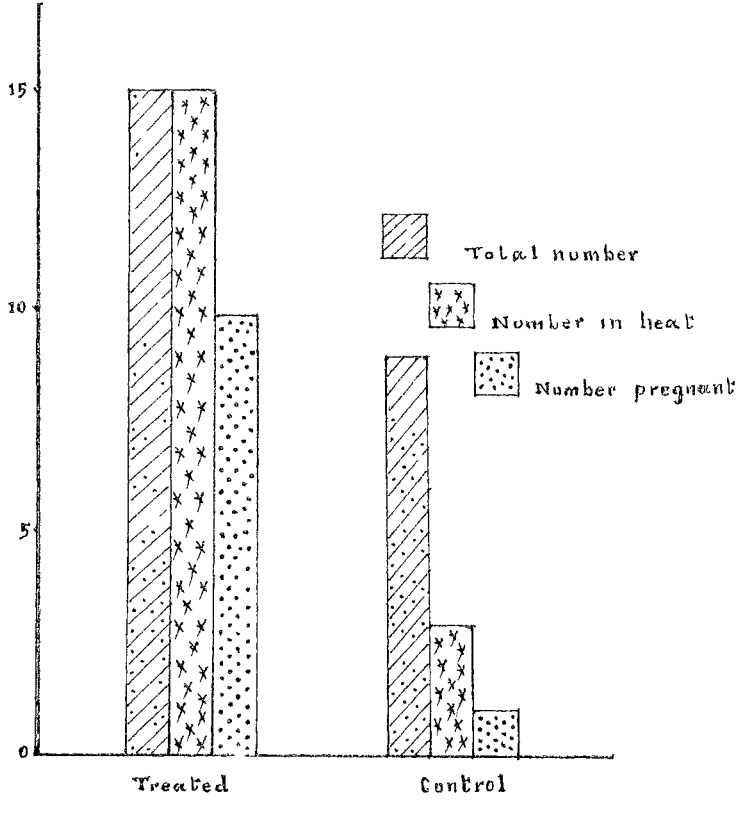
C
C
$C_6H_8O_7$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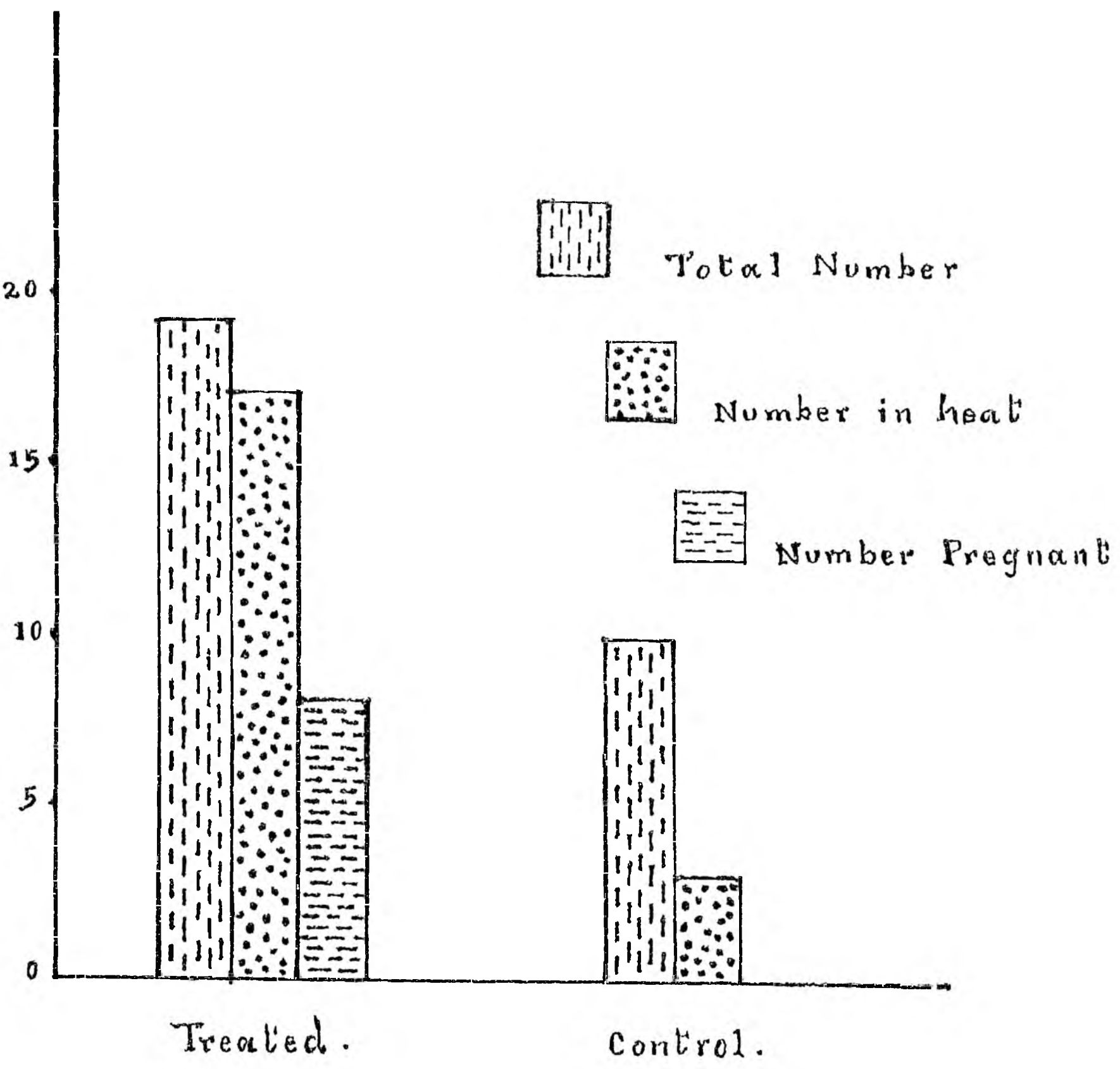
Total number
Number in heat
Number pregnant
Treated
Control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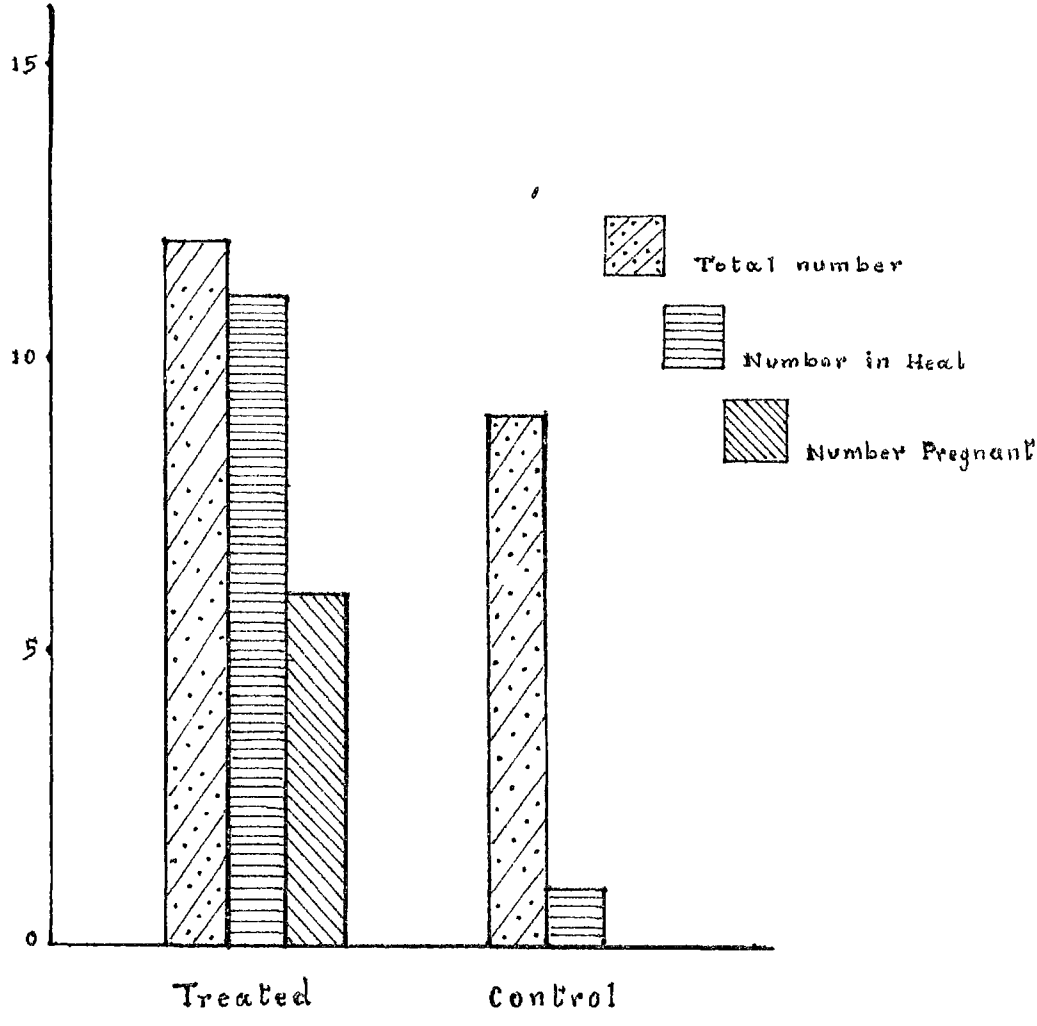
Total Number
Number in heat
Number Pregnant
Treated.
Control.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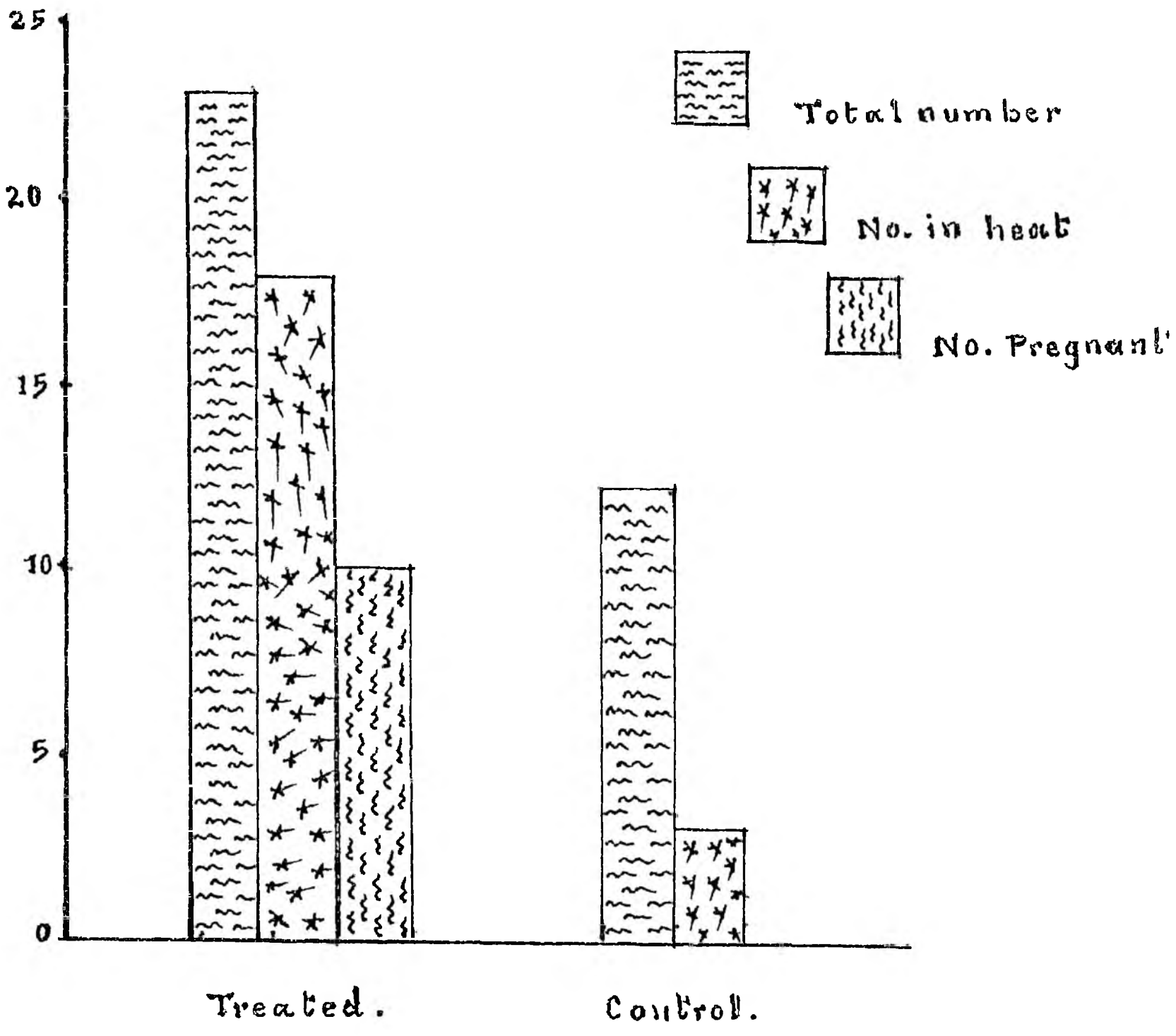
10
5
0
Total number
Number in Heal
Number Pregnant
Treated
Control


25
20
15
10
5
0
Total number
No. in heat
No. Pregnant
Treated.
Control.

DISCUSSION

DISCUSSION

Anoestrum is the principal symptom of many conditions that may affect the oestrous cycle and is one of the major causes of infertility in bovines. The magnitude of anoestrum in a number of instances is so serious that the economic losses are multifold. Treatment aspects remained varied in general and received very limited attention in our country, probably due to the complex causes of the problem. The present study was therefore taken up to find out the incidence, magnitude of prevalence and possible etiological factors for 'true anoestrum' among crossbred cattle with the ultimate object of evolving suitable corrective measures for the same.

The material used for the present investigation consisted of 184 crossbred cows and 76 crossbred heifers above 18 months of age maintained in the livestock farms attached to the Kerala Agricultural University and 401 crossbred cows and heifers brought for infertility treatment at various anti-sterility camps in the State. The stock of cattle maintained in the University farms were under identical conditions of management and sexual health cover.

Perusal of the data presented in table I revealed that out of 184 cows, 52 (28.3 per cent) were reported to be

anoestrous, though, detailed repeated examinations could reveal only 32 (17.4 per cent) to be in 'true anoestrum' and 15 (8.2 per cent) in normal cycle. It was also observed that four cows were in silent heat (2.2 per cent) and one had cysts in both the ovaries (0.5 per cent). Similarly among 76 heifers, anoestrum was reported in 22 (28.9 per cent) but only 17 (22.4 per cent) were found to be in 'true anoestrum' and three (3.9 per cent) were found cycling. Bilateral ovarian hypoplasia and cystic ovaries were observed in one heifer (1.3 per cent) each. It is also evident from table II that out of 401 cows and heifers presented in the various anti-sterility camps, 200 (49.9 per cent) were reported to be in anoestrum, but gynaecoclinical examinations revealed only 113 (28.2 per cent) to be in 'true anoestrum'. Thirtyone cows (7.7 per cent) were cycling and 7 (1.7 per cent) were in heat. The genitalia of 36 heifers (9 per cent) were underdeveloped, and one had hypoplasia of both ovaries (0.2 per cent). Cystic ovary was detected in one case (0.2 per cent) and early pregnancy in 11 cases (2.7 per cent). The variation existing in the animals reported to be in anoestrum and the true functional status based on the gynaecoclinical examinations may be attributed to the high incidence of silent oestrum and sub-oestrum especially during post-partum period and post-pubertal period. Besides, failure of detection of heat and early pregnancy also

contributed to the high incidence of apparent anoestrum. Observations similar to this have been made by Roberts (1971) and Luktuke and Sharma (1978).

Authentic data on the incidence of 'true anoestrum' among crossbred cattle under farm conditions are lacking. However, Sane (1972) reported an incidence of 22.2 per cent post-partum anoestrum in a herd of Gir cows under rigid sexual health control. Araujo et al. (1973) also reported an incidence of 17.5 per cent of true anoestrum under similar conditions. Kaikini et al. (1977) reported an incidence of 15 to 20 per cent anoestrum in an assorted herd of non-descript cows. On the other hand, Hollan and Branton (1975) reported an incidence of 19 to 30.4 per cent anoestrum, while Jain (1975) observed 52.4 per cent in crossbred cattle. Deshpande and Sane (1977) reported that the incidence of post partum anoestrum ranged from 20 to 30 per cent. Similarly, the incidence of anoestrum was reported to be 43 per cent (Luktuke and Sharma, 1978), 30 per cent (Patil and Khan, 1978), 31 per cent (Ansari, 1978) and 13.61 per cent (Patil and Khan, 1979) in cows. Mathew and Namboodiripad (1979) observed that the incidence of infertility due to anoestrum ranged between 23.07 to 41.42 per cent and 20 to 51.72 per cent in crossbred cows and heifers respectively of varying exotic blood levels. In general, it could be observed that wide variation existed

between the incidence of 'true anoestrum' reported by earlier workers and the present observations. This could be attributed to the different managemental practices as reported by Kodagali (1978). The differences in the breeds and agro-climatical conditions of the area might have also contributed to the above variation.

It could be seen from table III and IV that anoestrum in 21 cows and 35 heifers was due to nutritional factors. While the serum calcium level of these animals was within the normal range (10.15 mg/dl for cows and 10.89 mg/dl for heifers), the serum inorganic phosphorus level was comparitively low. (4.12 mg/dl and 4.05 mg/dl for cows and heifers respectively). It could also be seen that four cows and 13 heifers had serum inorganic phosphorus level below 4 mg/dl. The Ca.P ratio was 2.69 and 2.46 for heifers and cows respectively. The Ca.P ratio presently observed was at variance with the normal value (Arora, 1977). Hignet and Hignet (1951), Boyd (1970), Sampath and Kumar (1977), Arora (1977), Neelakantan and Nair (1979) and Samad et al. (1980) reported that wide Ca.P ratio retarded fertility. Thus, anoestrum observed in the experimental animals could be attributed to the wide Ca.P ratio. According to King (1971) and Maynard and Loosli (1973) the serum copper level of normal cows should be 100 μg/dl while the mean serum copper level of these cows and heifers

were observed to be 88.32 g/dl and 91.07 g/dl respectively. King (1971) reported that oestrous cycle would be suppressed when the blood copper level was even slightly subnormal. Sane (1958), Mahadevan and Zubairy (1971), King (1971) and Deas et al. (1979b) also opined that low blood copper level would cause anoestrum in cattle. The hypocuprosis presently observed may also be attributed as a cause of anoestrum in the animals studied. However, the mean serum protein level (6.54 g/dl and 6.83 g/dl) serum glucose level (48.49 mg/dl and 51.60 mg/dl) and haemoglobin level (9.16 g/dl and 9.70 g/dl) of the anoestrous heifers and cows respectively were well within the normal limits for cows; the normal values being 6 to 8 g/dl, 35 to 55 mg/dl and 8 to 15 g/dl for protein, glucose and haemoglobin respectively (Blood et al. 1979).

The true anoestrum in 24 cows and 29 heifers was not due to nutritional causes, as they showed normal levels of inorganic phosphorus, calcium, haemoglobin, copper, protein and glucose and a normal Ca.P ratio as revealed by haematological studies. The results of treatment of these animals with Fertivet revealed that all the cows treated came into oestrum at an average interval of 5.73 days, while only three out of nine in the control group came in heat within a mean period of 23.7 days; the variation between the groups being

highly significant (Table V). It could also be seen from table VI that among treated heifers 89.47 per cent came into heat within a mean period of 5.47 days, while only 30 per cent of the control group exhibited oestrum within a mean period of 27.33 days, the variation being highly significant. Kodagali et al. (1978) also tried 'Fertivet' for inducing ovulation in anoestrous cows. 'Fertivet' was capable of inducing ovulation in all the cows within 60 hours at the dose of 750 mg per cow. There are several reports to indicate that Fertivet was very effective in inducing ovulatory oestrum in anoestrous cows (Deshpande et al., 1976; Kaikini et al., 1977; Pendse et al., 1977; Kaikini et al., 1978a and Manjunath, 1979) and buffaloes (Deshpande et al., 1976; Hukeri et al., 1979). 'Fertivet' treatment in the present study required a mean period of 5.33 and 5.47 days to induce oestrum in cows and heifers respectively which is almost in agreement with the findings of Deshpande et al. (1976) and Kodagali et al (1978). However, Chauhan and Singh (1979) reported that Fertivet treatment to deep anoestrous animals with smooth ovaries had little or no effect.

The present study also revealed that among treated cows 10 (66.67 per cent) conceived while only one from the control became pregnant (11.1 per cent). The difference in the

conception rate between the two treatments was significant. Variations in the conception rates between treated and control groups of heifers were also observed. This is essentially in agreement with the findings of Kodagali (1978) and Manjunath (1979), who reported 60.31 per cent and 66.6 per cent conception in the treated cows. The conception rate in the heifers was also significantly higher among the treated group than among the control. The present study also revealed that 'Fertivet' at the dose of 300 mg for five days, was satisfactory which is essentially in keeping with the findings of Deshpande et al. (1976); Kaikini et al. (1977) and Manjunath (1979), while Pandse et al. (1977) obtained good results at a dose of 450 mg daily for three days. However Kodagali (1978) recommended a dose of 750 mg per animal for good results.

From the forgoing paragraphs, it is evident that 'Fertivet' induces ovulatory oestrum in cows and heifers in prolonged anoestrous condition and improves the conception rate. It is postulated that 'Fertivet' stimulates hypothalamo-pituitary axis to release gonadotrophic releasing hormone (GnRH), which inturn triggers the release of pituitary gonadotrophins, particularly LH and thus induce ovulation. It may also inhibit the feed-back regulating effect of oestrogen on

pituitary. The present findings are in full agreement with those of Anon (1976), but contrary to the report of Roberts (1971) who found it anti-estrogenic and also inhibitary to LH release. It is worthwhile to investigate the circulating blood levels of LH, FSH, oestrogen and progesterone and urine oestrogen and pregnandiol levels of animals to throw more light on its mode of action, site of reception and rate of excretion before, during and after treatment.

The results of treatment of 'true anoestrum' due to nutritional causes with 'Fertimin' revealed that 11 out of 12 (91.67 per cent) cows showed ovulatory oestrum within an average period of 38.8 days, while in the control group only one out of nine (11.1 per cent) exhibited oestrum. Similarly, in heifers heat was induced within a period of 27.7 days in 18 out of 23 (78.26 per cent), while only three out of 12 (25 per cent) in the control group exhibited oestrum. The variation between treated and control animals in both trials were highly significant. It could also be observed that from among treated groups six cows (50 per cent) and 10 heifers (43.48 per cent) became pregnant while none of the animals in the control groups conceived during the period of observation. The variation observed in conception rate between treated and control groups were also significant in both cases.

The significant response of the treated animals in respect of induction of oestrum and conception might be attributed to the correction of nutritional status of the anoestrous animals by supplementation of additional phosphorus and thus bringing the Ca.P ratio within normal range. This is in keeping with the findings of Morrow (1970), Dawson (1979), Sampath and Kumar (1977), Deshpande and Sane (1977), Singh et al. (1978), Scharp (1979) and Sanad et al. (1980) who have also reported that anoestrum in animals could be corrected and fertility improved by additional phosphorus supplementation. Presence of copper in 'Fertimin' might also have enhanced the serum copper level. Sane (1958), Livishy et al.(1966), Mahadevan and Chhabry (1969), King (1971), Sampath and Kumar (1977) and Hunter (1977) reported satisfactory results in correction of anoestrum and improvement of fertility by supplementation of copper.

To sum up, it could be stated that there is high incidence of infertility due to anoestrum among crossbred cattle in the State and the causes of anoestrum appears to be multifold. Supplementation of minerals and vitamins to anoestrous animals would be of value in correcting this malady to some extent. Similarly, it also appears that anoestrum due to non-nutritional causes could be corrected and fertility restored

by administration of Fertivet. However, further investigation on the mode of action is warranted.

SUMMARY

SUMMARY

The aim of the present investigation was to assess the incidence and magnitude of prevalence of anoestrum among crossbred cattle in Kerala and to find out its etiological factors with the ultimate object of evolving effective curative measures for the same.

The material used for the present investigation consisted of 184 crossbred cows and 76 crossbred heifers above 18 months of age maintained in the livestock farms attached to the Kerala Agricultural University and 401 crossbred cows and heifers presented for treatment in various anti-sterility camps at different places. The farm animals were maintained under identical conditions of feed and management and were under rigid sexual health cover. Based on the breeding history and detailed gynaecoclinical examinations the incidence of 'true anoestrum' was assessed. The etiological factors for 'true anoestrum' was determined by haematological studies. Cows and heifers in 'true anoestrum' which had shown normal values of various nutrients were treated with Fertivet tablets at the dose of one tablet (300 mg) daily for five days. Anoestrous cows and heifers which had shown deficiency or imbalances among any nutrients were treated with Fertimin brand of mineral mixture at the rate of 30 g daily for 30 days.

in heifers and cows respectively). The serum copper level of these animals were comparatively subnormal, the values being 91.47 and 88.32 µg/dl respectively for heifers and cows. Blood study also revealed that the anoestrum in 24 cows and 29 heifers was not due to nutritional factors.

The results of treatment with Fertivet for anoestrous cows and heifers due to non nutritional factors revealed that 100 per cent of cows and 89.47 per cent of heifers showed ovulatory oestrum within a mean period of 5.73 and 5.43 days respectively. The cows and heifers which showed heat in the control groups were only 33.3 per cent and 30 per cent respectively. The variation between the experimental and control groups were highly significant. The conception rate in the experimental groups was 66.67 per cent for cows and 42.11 per cent for heifers. Among the control animals, only 11.1 per cent cows conceived while none of the heifers became pregnant. The variations in both the groups were significant. These results showed that Fertivet not only induced heat but also improved the conception rate in the anoestrous animals.

Fertimin, a mineral mixture could induce ovulatory heat in cows and heifers in anoestrum due to nutritional causes. Among 12 cows treated, 11 (91.67 per cent) came into heat while in heifers 18 out of 23 (78.26 per cent)

The breeding history of the farm animals revealed that out of 184 cows and 76 heifers, 52 (28.3 per cent) cows and 22 (28.9 per cent) heifers were apparently anoestrous. Repeated gynaecoclinical examinations of these animals could reveal that 'true anoestrum' existed only in 32 cows (17.4 per cent) and 17 heifers (22.4 per cent). Fifteen cows (8.2 per cent) and three heifers (3.9 per cent) were cycling and four cows (2.2 per cent) were in heat. Cystic ovary was detected in one cow (0.5 per cent) while bilateral hypoplasia of ovary and cystic condition of ovaries were observed in one heifer each (1.3 per cent each). Among 401 cows and heifers presented in the antisterility camps, 200 (49.9 per cent) were reported to be anoestrous but on detailed investigations it was evident that only 113 (28.2 per cent) were in 'true anoestrum'. Thirty animals (7.7 per cent) were cycling and seven (1.7 per cent) were in heat. Incidence of early pregnancy, underdeveloped genitalia, hypoplasia of ovaries and cystic ovary were detected in 11 (2.7 per cent), 36 (9 per cent), one (0.2 per cent) and one (0.2 per cent) cases respectively.

Haematological studies revealed that anoestrum in 46.6 per cent cows and 54.65 per cent heifers were due to nutritional factors. The serum phosphorus levels were in border-line which caused a wide Ca.P ratio (2.46 and 2.69

came into heat whithin a period of 38.8 and 27.77 days respectively. Among the control groups only one cow out of nine (11.1 per cent) and three heifers out of 12 (25 per cent) came into heat within a period of 20 and 30.67 days respectively. Analysis of the data showed highly significant differences between control and treated groups. The conception rate in the treated groups were 50 per cent for the cows and 43.48 per cent for heifers while in the control group no animal conceived. These differences were also significant.

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STUDIES ON
ANOESTRUM IN CROSSBRED CATTLE

BY

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ABSTRACT OF A THESIS

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ABSTRACT

The object of the study was to assess the incidence of anoestrum among crossbred cattle of Kerala and to find out the possible etiological factors so as to evolve suitable therapeutic measures for the same. For this, 184 crossbred cows and 76 crossbred heifers above 18 months of age maintained in the livestock farms attached to the Kerala Agricultural University and 401 crossbred cows and heifers presented for treatment at various infertility camps in the State were utilised. The incidence of anoestrum was assessed from the breeding history and detailed gynaecoclinical examinations. The nutritional status of the animals was determined by haematological examinations. The anoestrous animals showing nutritional deficiency were treated with Fertimin brand of mineral mixture and those showing normal nutritional status were treated with 'Fertivet'.

Among the farm animals, 28.3 per cent of cows and 28.4 per cent of heifers were in apparent anoestrum though true anoestrum was observed only in 17.4 per cent of cows and 22.4 per cent of heifers. The other cases of apparent anoestrum were due to silent oestrum (3 to 15 per cent), cystic ovaries (0.5 to 1.3 per cent) and hypoplasia of ovaries (1.3 per cent). Similarly among the animals brought for treatment at various infertility camps, true anoestrum

was observed only in 28.2 per cent cases though 49.9 per cent were reported to be anoestrous. The other cases were early pregnancy (2.7 per cent), cycling (7.7 per cent), cystic ovaries (0.2 per cent), underdeveloped genitalia, (9 per cent) ovarian hypoplasia (0.2 per cent) and in heat (1.7 per cent)

Wide Ca.P ratio (2.69 and 2.46) and subnormal copper level (88.32 g/dl and 91.07 g/dl) were detected in 46.6 per cent of cows and 54.65 per cent of heifers respectively in true anoestrum.

'Fertivet' was capable of inducing ovulatory oestrum in 100 per cent of cows and 89.47 per cent of heifers in true anoestrum due to non nutritional causes within a period of 5.73 and 5.43 days respectively, while only 33.3 per cent of cows and 30 per cent of heifers in the control group came in heat; the variations being highly significant. Similarly, the conception rate in the treated groups was 66.6 per cent for cows and 42.11 per cent for heifers, while only one cow from the control group conceived, the variation in both the cases being significant.

Treatment with 'Fertirun could induce ovulatory oestrum in 91.67 per cent of cows and 78.26 per cent of heifers within a mean period of 38.0 and 27.77 days respectively, while the response in the control groups were only 11.1 per cent for

cows and 25 per cent for heifers respectively, the difference being highly significant in both the cases. Significant variations were observed in conception rate between experimental and control groups, the values being 50 per cent for cows and 43.48 per cent for heifers in the experimental group. None of the animals in control groups conceived.