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An Evaluation of the Effectiveness of Antibiotic Treatment at a Prebreeding Estrus on Subsequent Reproductive Efficiency

Kenneth C. Lamar

University of Tennessee - Knoxville

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I am submitting herewith a thesis written by Kenneth C. Lamar entitled "An Evaluation of the Effectiveness of Antibiotic Treatment at a Prebreeding Estrus on Subsequent Reproductive Efficiency." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Science.

Don O. Richardson, Major Professor

We have read this thesis and recommend its acceptance:

R. L. Murphee, M. J. Montgomery

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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and recommend its acceptance:

R. L. Murphree

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AN EVALUATION OF THE EFFECTIVENESS OF ANTIBIOTIC
TREATMENT AT A PREBREEDING ESTRUS ON
SUBSEQUENT REPRODUCTIVE EFFICIENCY

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Kenneth C. Lamar

June 1976

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ABSTRACT

An experiment was conducted to evaluate the effectiveness of a douche with an antibiotic formula to improve reproductive efficiency in dairy cows.

A total of 102 cows was utilized in the experiment. The 81 Holstein cows were divided into four groups. These groups were untreated cows which had normal post-calving recuperation (N-C), treated cows which had normal post-calving recuperation (N-T), untreated cows which had experienced post-calving complications (M-C), and treated cows which had experienced post-calving complications (M-T). The 20 Jersey cows were divided into treated and untreated groups (N-T and N-C). The treatment consisted of a nitrofurazone-neomycin mixture in a 7 to 1 ratio.

The effectiveness of the treatment was evaluated by comparing the interval to first heat, number of prebreeding heats, interval to first service, interval to conception, and conception rates resulting from one and two services.

The analysis indicates that there was no difference ($P > .05$) in days to first heat, number of prebreeding heats, or days to first service.

In the Holstein data, the M-T group had the highest conception rate. There was a difference ($P < .05$) in conception rates between the groups. There was no difference

($P > .05$) between conception rates of the N-C and N-T groups. However, the trend was for the N-T group to have a higher conception rate.

In the Jersey data, there were no differences in conception rates between the two groups on first service or first and second service.

There was no difference ($P > .05$) between the groups in number of days to conception for the animal conceiving in two or less services in the Holstein data. However, it is the author's opinion that there would be a difference if the experiment had been continued. This is based on the fact that the majority of cows in group M-C were still open at the conclusion of the experiment. There were no differences ($P > .05$) between the groups in days to conception in the Jersey cows.

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CHAPTER I

INTRODUCTION

Although heavily researched, reproduction inefficiency is still one of the major problems of the dairy industry. At the present time only 50 per cent of the cattle bred conceive with the first service, thus an average of two services is required to produce one live calf. However, two services per conception is not the major problem per se, the major problem is the lost time to conception. This is magnified by the fact that only 50 per cent of the estrus periods on the average are detected. Fifty per cent conception complicated by only 50 per cent heat detection yields only 25 per cent conception on the first heat during the breeding period. Dairy cattle are not usually bred until first heat after 60 days. These factors will extend the days to conception well over 100 days, and make a 12 month calving interval impossible to achieve. In fact, it sometimes results in calving intervals of 14-15 months which are major economic problems.

The reasons for poor reproductive performance are not clearly understood. Many reasons have been advocated as causing reproduction failure. Among these are hormonal imbalance, poor nutrition, anatomical abnormalities, reproductive diseases, non-specific infections and others.

Many investigators classify only 10 per cent of the total cow population as problem breeders. A cow that conceives within 3 to 4 services is considered normal.

Failure of fertilization, implantation, and embryonic death may be caused by non-specific uterine infections. An inflammatory condition of the uterus could produce an unfavorable environment for fertilization or implantation. Infections can also produce scar tissue that could block passage of sperm or ova through the oviducts. Scar tissue in the endometrium of the uterine horns also creates an unfavorable site for implantation. This could result in failure of implantation or abortion.

The total effect of uterine infections is hard to assess due to the fact that little or no work has been done with untreated endometritis. Many of the experiments conducted with repeat breeders, eliminated cows that had any evidence of uterine infections or anatomical abnormalities due to these infections.

The purpose of this experiment was to evaluate the improvement in reproductive efficiency resulting from the administration of an antibiotic douche at the first postpartum estrus.

CHAPTER II

REVIEW OF LITERATURE

I. EFFECTS OF MISCELLANEOUS UTERINE INFECTIONS

Severe Endometritis

Non-specific uterine infections are the major cause of endometritis. Severe endometritis that occurs within a few days of parturition was described by Arthur (4) as puerperal metritis. It is usually accompanied by retention of foetal membranes. Bacteria invade the non involuted uterus, colonize and produce toxins which cause severe systemic symptoms. A reddish, serous vaginal discharge accompanies the metritis. The uterus is distended with toxic exudate. This type of metritis can cause loss of appetite, lowered milk production, general unthriftiness, and even death in the more severely affected cases.

A thick vaginal discharge follows the initial stage of puerperal metritis with pyometria and cystic degeneration of the ovaries if symptoms are unchecked (40).

Boyd (12) suggested that postpartum metritis inhibits development of the Graafian follicles. He stated that if the inflammatory condition does not regress and a considerable amount of pus remains in the uterus, development of Graafian follicles is inhibited and there is no cyclic activity. Lynn

et al. (44) and others (8, 25, 28) confirmed that infections do delay estrus. It appears that the metritis may inhibit the ovarian function without interfering with the animal's health. This suggests that the infected uterus interferes with the hormonal and nervous control system.

The reduction in ovarian function complicates matters by decreasing the resistance of the uterus to infection (12). The susceptibility of the uterus to infections has been shown to increase during the luteal period (9, 10, 11, 26, 54, 62).

Postpartum endometritis may also delay conception by delaying uterine involution (12). Johanns et al. (37) and Morrow et al. (48) suggest that complete uterine involution should occur in normal cows by 21 to 24 days postpartum. Buch et al. (14) reported that complete involution does not occur until 47 days. Various researchers (14, 37, 48) have agreed that uterine infections contribute to delayed involution and that complete involution is necessary for maximum conception.

Mild Endometritis

After the uterus has involuted and normal cycles have been reestablished, infections can still cause reproductive failure (12). Roberts (52, 53) suggests that these infections may be either enzootic or sporadic. Infections can cause endometritis which can result in embryonic death by attacking the embryo directly or by producing an unfavorable environment for implantation. Hawk et al. (32) and Foley

and Reece (23) indicated that a potential result of mild uterine infections is embryonic death.

The persistence of the milder cases of endometritis into the breeding period are not usually characterized by extreme uterine enlargement (4, 13, 53). Roberts (52) describes this type of metritis as very difficult to detect by rectal examination. He does suggest that in the more pronounced cases there may be a slight discharge, especially at the time of estrus. Occasionally the mucus that accompanies estrus is cloudy. A mild cervicitis may be present with the endometritis. Rectal examination of the uterus may reveal that the uterine horns are thick walled, with one horn being slightly enlarged. Other researchers (12, 13, 18, 19, 20) state that these infections are very difficult to detect without special equipment and techniques.

II. METHODS OF EVALUATING EFFECT OF ENDOMETRITIS

Endometrial Damage

Dawson (18, 19, 20) showed that infections can cause permanent damage to the endometrium and this contributes to lowered fertility. Postmortem examinations of repeat breeding cows showed that 51.5 per cent of the cows discarded for failure to breed had either bursitis or endosalpingitis. Fluid injection tests (19) were used to show that a majority of these oviducts were impassable to ova. Observations of 300 cows showed that 59 of the uteri appeared abnormal, 19

others were devoid of glands and surface epithelium (20). In 73 of the cows, endometrium glands were replaced by masses of infiltrated leucocytes. Other workers (1, 29, 47, 50) reported similar abnormalities. However, Casida (15) and others (39, 59) suggest that only a small percentage of repeat breeding cows have endometrial damage that would impair fertility. The inconsistent conclusions may be explained by variation in the extent of the examinations, the sensitivity of evaluating the damage, and the difference between herds that various researchers used.

Bacterial Cultures

One method used to link infertility to infection has been the presence of an organism in cultured specimens from the uterus of repeat breeders. Easley and Leonard (21) showed that repeat breeder cows had a much higher incidence of organisms present in the uterus than did the normal cows. Eighty per cent of the repeat breeders had pathogenic strains of organisms present in the uterus. Others (1, 2, 5, 21, 27, 29, 30, 31, 35, 41, 42, 49, 51, 56, 58) have shown high incidences of organisms present.

The most common type of organisms present were Corynebacterium pyogenes, Streptococcus pyogenes, Micrococcus pyogenes, Pseudomonas aeruginosa, Escherichia coli, and diphtheroid species (27).

Controversy exists over the effect of these organisms on reproductive efficiency. Joulbert et al. (36) was able

to isolate streptococci, staphylococci, and Escherichia coli from 75 per cent of the uteri of normal cows. He suggests that these bacteria have little or no effect on the performance of the cow. Gunter (27) concedes that bacteria are present in the normal uterus, but that they are predominantly saprophytic strains whereas in the difficult breeder the genera present are primarily pathogenic strains. Hawk et al. (33) and other workers (15, 39) confirm that microbial infections do cause some infertility, but only in a very few cases.

III. TREATMENT OF UTERINE INFECTIONS

Postpartum Treatment

One approach to the control of uterine infections is a routine postpartum treatment. Fuquay (24) treated cows with neomycin boluses, 24 hours postpartum, and was unable to show any beneficial effects of uterine treatment. In fact, the treatment was assessed as being detrimental, causing an increase in the number of services per conception and the number of days to conception. Cseh (17) however demonstrated a positive response to postpartum treatment with improved conception rates, shorter time to conception, and early stimulation of the ovary to cyclic activity. Other researchers (3, 6, 46, 55, 56, 60) have shown improved conception rates by using irrigation techniques or antibiotic uterine douches.

Treatment at Estrus

Other workers (3, 16, 52, 64) have evaluated the effect of treatment of the uterus with various antibiotics at estrus or prior to breeding. This was followed by breeding at the subsequent estrus. Results have ranged from no apparent benefit to greatly improved conception rates. The results are summarized in Table I.

Treatment Post Breeding

Treatment 4 to 24 hours post breeding has been advocated by some researchers (43, 52, 55). This regime does not affect the sperm as within a few hours the sperm will have moved into the oviducts (22) where they will not come into contact with the antibiotic formula.

Treatment during the time the cow is still in estrus allows easy passage through the cervix. The resistance of the uterus to induced infection is highest at this time. The antibiotic formula will be excreted or absorbed by the uterus before the ovum reaches the uterus (63).

Treatment via this method has produced favorable results in most experiments. The results are summarized in Table II.

Antibiotic Residues in Milk

Uterine infusions of antibiotics may result in antibiotic residues in the milk if the milk is not withheld from marketing channels for some hours after treatment. At the present time there are not any restrictions on antibiotics

TABLE I
SUMMARY OF EXPERIMENTAL RESULTS OF PRESERVICE ANTIBIOTIC
TREATMENTS ON CONCEPTION RATES

Reference	Treatment used	Per cent conception at first serv. after treatment	Per cent conception at two serv. after treatment	Per cent conception control
Roberts (52)	Preservisal	38.6	55.4	
Roberts (52)	Iodine sol.	51.1	63.9	
Roberts (52)	Throthricin	37.8	51.1	
Roberts (52)	Penicillin and streptomycin	46.3	60.0	
Roberts (52)	Penicillin and streptomycin in water and oil sol.	43.2	52.3	
Woelffer (64)	Lugol's solution or tyrothricin	62.0		22.0
Andesen & Schmidt (3)	4% lotagen	72.3	85.5	42.8
Andesen & Schmidt (3)	8% lotagen	57.3	69.8	42.8

TABLE II

SUMMARY OF EXPERIMENTAL RESULTS OF POSTSERVICE ANTIBIOTIC TREATMENTS
ON CONCEPTION RATES

Reference	Treatment used	Per cent conception at first serv. after treatment	Per cent conception at two serv. after treatment	First serv. conception controlled
Lindley (43)	Streptomycin sulfate and sodium or potassium penicillin	64.6	78.1	33.3
Lindley (43)	Streptomycin sulfate and sodium or potassium penicillin	51.0	60.8	33.3
Lindley (43)	Streptomycin sulfate and sodium or potassium penicillin	77.7	88.9	33.3
Hjerpe (34)	Procaine penicillin G and dihydro streptomycin	68.4		60.6
Saratsis (55)	Tardomyocel L suspension	72.3	85.5	

infused into the uterus; however intrauterine therapy is under evaluation by the F.D.A. This could pose a problem if regulations are changed.

Seguin et al. (57) has shown that sulfonamides, including sulfamerazine, sulfacetamide, and sulfapyridine, infused intrauterine at the rate of 107 and 214 mg/kg. of body weight, are detectable in blood and milk 24 to 48 hours after infusion. Oxytetracycline, infused intrauterine at the rate of 4 mg/kg. of body weight is also detectable in milk 24 hours post treatment. Similar studies by Messer et al. (45) has shown that penicillin can be detected in the milk 24 hours post treatment. Uhlig (61) showed penicillin residues in milk up to 48 hours post treatment. All the researchers agree that milk should be discarded for 24 to 48 hours post treatment.

CHAPTER III

EXPERIMENTAL PROCEDURE

Objective of Experiment

The major objective of this experiment was to evaluate the effectiveness of a douche with an antibiotic formula on reproductive efficiency. The effectiveness of the treatment was evaluated by comparing the interval to first heat, number of prebreeding heats, interval to first service, interval to conception, and conception rates resulting from one and two services.

The experiment was originally designed to compare reproductive efficiency between a treated and a control group. The treated group would receive a prebreeding treatment of an antibiotic formula. The control group would receive no treatment prior to breeding. However, the high incidence of retained placentas and severe endometritis made it necessary to subdivide the cows into normal and abnormal calving groups. The abnormal cows received an average of 2.8 postpartum treatment(s) for endometritis.

Animals

Experiment 1. Eighty-one Holstein cows that calved during the period of August 15 to January 9 from the University of Tennessee's milking herd were assigned to one

of two experimental groups. The first group consisted of cows that shed their placental membranes and had no abnormal vaginal discharge of pus. These cows were considered normal.

The abnormal cows either had retained placental membranes or had a persistent, foul smelling vaginal discharge. In most cases retained placentas were accompanied by endometritis.

The placental membranes were removed by a veterinarian within 48 hours after calving. All cows in this category were routinely treated with an antibiotic douche every three to five days as long as the symptoms persisted. All cows were rectally palpated and treatment continued until involution was progressing and no abnormalities could be detected. This antibiotic douche consisted of a sulfanitrofurazone mixture (Formula I). The douche was administered intrauterine with a metal catheter attached to a rubber tube. Each treatment consisted of 500 ml of the mixture.

Both normal and abnormal cows were randomly divided into subgroups. In each of these groups alternate cows were treated with a second antibiotic formula 42 days postpartum or at first heat whichever came first. The average time of treatment was 39.5 days. The other half of the cows did not receive the second treatment. The normal cows receiving no treatment at first heat are labeled N-C; the animals receiving the second treatment at first heat

were labeled N-T. The abnormal cows receiving no treatment at first heat are labeled M-C; the animals receiving both treatments are labeled M-T.

The second treatment (Formula II) consisted of a nitrofurazone-neomycin mixture in a seven-to-one ratio. This mixture was infused into the uterus with a standard inseminating tube attached to a 60 ml syringe.

Experiment II. Twenty-one Jersey cows that calved during the period of August 15 to January 6 from the University of Tennessee dairy herd were also randomly divided into subgroups. Retained placenta and severe endometritis were not a problem in the Jersey herd. Half of the cows received no treatment prior to breeding. The other half received 120 ml of Formula II at an average of 38.9 days.

All cows on both experiments were observed twice daily for abnormal discharges. Cows were observed during the time of day that they were resting. Observation at this time presented a greater chance of seeing a discharge because the cow would be lying down, permitting better drainage. Cows were observed three times daily for any signs of heat. All prebreeding heat dates were recorded. All cows were bred at first heat after 60 days postpartum. Pregnancy was determined at 60 days post breeding by rectal palpation.

Estrus activity and days to conception were evaluated with the use of the analysis of variance. Conception results

were evaluated with the use of chi square procedures. At the time of this analysis, the data were not completed for certain variables. For first service conception data the status for one cow in each of N-C, N-T, and M-T was unknown. In addition, the results for two services were unknown for 2, 4, 3 and 1 cows in N-C, N-T, M-C, M-T, respectively.

CHAPTER IV

RESULTS AND DISCUSSION

The results of Experiment I are summarized in Table III and IV, and the results of Experiment II are summarized in Table V and VI.

Estrus Activity

In Experiment I, the average interval to the first heat for the four treatments was 35.8, 46.4, 50.0, and 44.3 days for treatments N-C, N-T, M-C, and M-T. The range among cows varied from a low of six days to a high of 188 days to first heat. Group N-C had the shortest average number of days to first heat. Group M-T, which had severe post-calving problems and received both treatments, had a surprisingly short interval to first heat. It is the author's opinion that these cows with severe endometritis would have had a much longer interval to first heat than the normal calving cows. However, there was no difference ($P > .05$) between any of the groups. One possible reason for the lack of difference between the groups could be due to the tremendous variation in time to first heat between the individual cows. In Experiment II the average interval to first heat was 42.0 and 41.7 days. There was no difference ($P > .05$) between the two groups.

TABLE III

SUMMARY OF VARIOUS MEASURES OF ESTRUS ACTIVITY IN EXPERIMENT I

Estrous Activity	Group N-C*			Group N-T*			Group M-C*			Group M-T*		
	No. of cows	Mean**	Range	No. of cows	Mean**	Range	No. of cows	Mean**	Range	No. of cows	Mean**	Range
Interval to first heat	20	35.8 ^a	6-68	20	46.4 ^a	12-188	21	50.0 ^a	6-158	20	44.3 ^a	11-84
No. of prebreeding heats	20	1.30 ^b	0-2	20	1.35 ^b	0-3	21	1.05 ^b	0-2	20	1.50 ^b	0-4
Days to first service	20	69.3 ^c	57-82	20	77.5 ^c	57-188	21	84.5 ^c	52-158	20	76.2 ^c	60-106
No. of cows cycling within 45 days	12			14			11			10		
No. of cows cycling within 60 days	18			16			17			16		

* N-C refers to untreated normal cows; N-T refers to treated normal cows; M-C refers to untreated cows with post calving problems; M-T refers to treated cows with post calving problems.

**Means with the same superscripts are not significantly different ($P > 0.05$).

TABLE IV

SUMMARY OF CONCEPTION RESULTS FOR EXPERIMENT I

Conception Results	Group N-C*			Group N-T*			Group M-C*			Group M-T*		
	No. of cows	Mean**	Range	No. of cows	Mean**	Range	No. of cows	Mean**	Range	No. of cows	Mean**	Range
Conception rate first service	20	50.0 ^a		19	57.9 ^a		20	30.0 ^b		19	79.0 ^c	
Conception rate with two services	19	78.9 ^b		16	75.0 ^b		17	41.2 ^c		19	84.2 ^b	
Days to conception	15	77.7 ^a	67-105	12	76.2 ^a	62-113	7	75.0 ^a	59-99	16	76.9 ^a	60-132
No. of cows open after two services	4			4			11			3		

*N-C refers to untreated normal cows; N-T refers to treated normal cows; M-C refers to untreated cows with post calving problems; M-T refers to treated cows with post calving problems.

**Means for a given variable with different superscripts are different (P < 0.05).

TABLE V

SUMMARY OF VARIOUS MEASURES OF ESTRUS ACTIVITIES IN EXPERIMENT II

Estrus Activity	Group N-C*			Group N-T*		
	No. of cows	Mean**	Range	No. of cows	Mean**	Range
Interval to first heat	11	42.0 ^a	17-93	10	41.7 ^a	9-78
No. of pre-breeding heats	11	1.30 ^b	0-3	10	1.36 ^b	0-3
Days to first service	11	78.3 ^c	69-103	10	78.6 ^c	64-107
No. of cows cycling within 45 days	7			5		
No. of cows cycling within 60 days	8			9		

*N-C refers to untreated normal cows; N-T refers to treated normal cows.

**Means with the same superscripts are not significantly different (P > 0.05).

TABLE VI
SUMMARY OF CONCEPTION RESULTS FOR EXPERIMENT II

Conception Results	Group N-C*			Group N-T		
	No. of cows	Mean**	Range	No. of cows	Mean**	Range
Conception rate first service	10	30.0 ^a		10	50.0 ^a	
Conception rate with two services	9	88.9 ^b		9	88.9 ^b	
Days to conception	9	88.4 ^c	65-125	9	97.8 ^c	78-155
No. of cows open after two services	2			1		

*N-C refers to untreated normal cows; N-T refers to treated normal cows.

**Means with the same superscripts are not significantly different (P > 0.05).

The number of prebreeding heats was not different ($P > .05$) between the treatments in Experiment I or Experiment II.

The average intervals to first service were 69.3, 77.5, 75.0 and 76.9 days for cows in treatment groups N-C, N-T, M-C, and M-T. There was no difference ($P > .05$) between the four treatments. Jersey cattle on Experiment II also showed no difference ($P > .05$) in interval to first service.

Conception Results

In Experiment I, there was a difference ($P < .05$) between the four different treatments in first service conception rates. Group M-T had the highest first service conception rate with 79.0 per cent. Group M-C had the lowest conception of 30.0 per cent. These data indicate that the second treatment was beneficial in increasing conception rates among cows which previously had endometritis. The beneficial effects of this treatment on normal cows is less clear.

The normal cows, however, did not show any difference ($P > .05$) between the N-T group and the N-C group. However, the trend was for the treated cows to have a higher conception rate. There were also differences ($P < 0.5$) among treatments for conception to first and second services. This difference is reflected in the number of open cows in

each group at the conclusion of the experiment. The number of open cows after two services are 4, 4, 11, and 3 for groups N-C, N-T, M-C, and M-T, respectively.

Comparison of groups N-C and M-C with groups N-T and M-T show a difference ($P < 0.5$) between treated cows and non-treated cows on first service conception rates; however there was not a difference ($P > 0.5$) between the treated and control on two service conceptions. In Experiment II, there was no difference in conception rates between the two groups on first or first and second service.

The average interval to conception for the four treatments was 77.7, 76.2, 75.0, and 76.9 days for groups N-C, N-T, M-C, and M-T, respectively. These averages were very similar for the four treatments and there were no differences ($P > .05$) between the treatments. However, it is the author's opinion that the interval to conception will eventually be much higher for the M-C group due to the fact that the majority of these cows had not conceived at the conclusion of the experiment.

Early detection and treatment of uterine infections is a very important factor if high levels of reproductive efficiency are to be obtained. Treatment with antibiotic douches did improve conception rates, therefore, decreasing the number of cows open. Large numbers of cows open over 100 days becomes a very important economic liability to the dairyman. Post-calving cows should be observed closely for

any evidence of endometritis or placental retention. Any cows with these conditions should be treated promptly and thoroughly. These problem cows should be treated again at first heat with a second antibiotic formula. Cows should be observed closely for post-calving cyclic activity. Any cow not cycling within 45 days should be examined by a veterinarian. If uterine infections appear to be a major problem, routine treatment programs should be established.

CHAPTER V

SUMMARY AND CONCLUSIONS

The results of this experiment indicate that the post-partum antibiotic treatments combined with the prebreeding treatment are beneficial in improving conception rates.

The analysis indicates that there were no differences ($P > .05$) in days to first heat, number of prebreeding heats, or days to first service.

In Experiment I, the M-T group had the highest conception rate. There was a difference ($P < .05$) in conception rates between the groups. There was no difference ($P > .05$) between conception rates of the N-C and N-T group. However, the trend was for the N-T group to have a higher conception rate.

In Experiment II, there was no difference in conception rates between the two groups on first service or first and second service.

There was no difference ($P > .05$) between the groups in number of days to conception in Experiment I. However, it is the author's opinion that there would be a difference if the experiment had been continued. This is based on the fact that the majority of cows in group M-C were still open at the conclusion of the experiment. There were no differences ($P > .05$) between the groups in days to conception in Experiment II.

To improve reproductive efficiency, it is the author's opinion that:

1. Post-calving cows should be observed closely for any evidence of endometritis or placental retention.
2. Any cows with these conditions should be treated promptly and thoroughly.
3. Problem cows should be treated again at first heat with a second antibiotic formula.
4. Cows should be observed closely for post-calving cyclic activity.
5. Any cow not cycling within 45 days should be examined by a veterinarian.
6. If uterine infections appear to be a major problem, routine treatment programs should be established.

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